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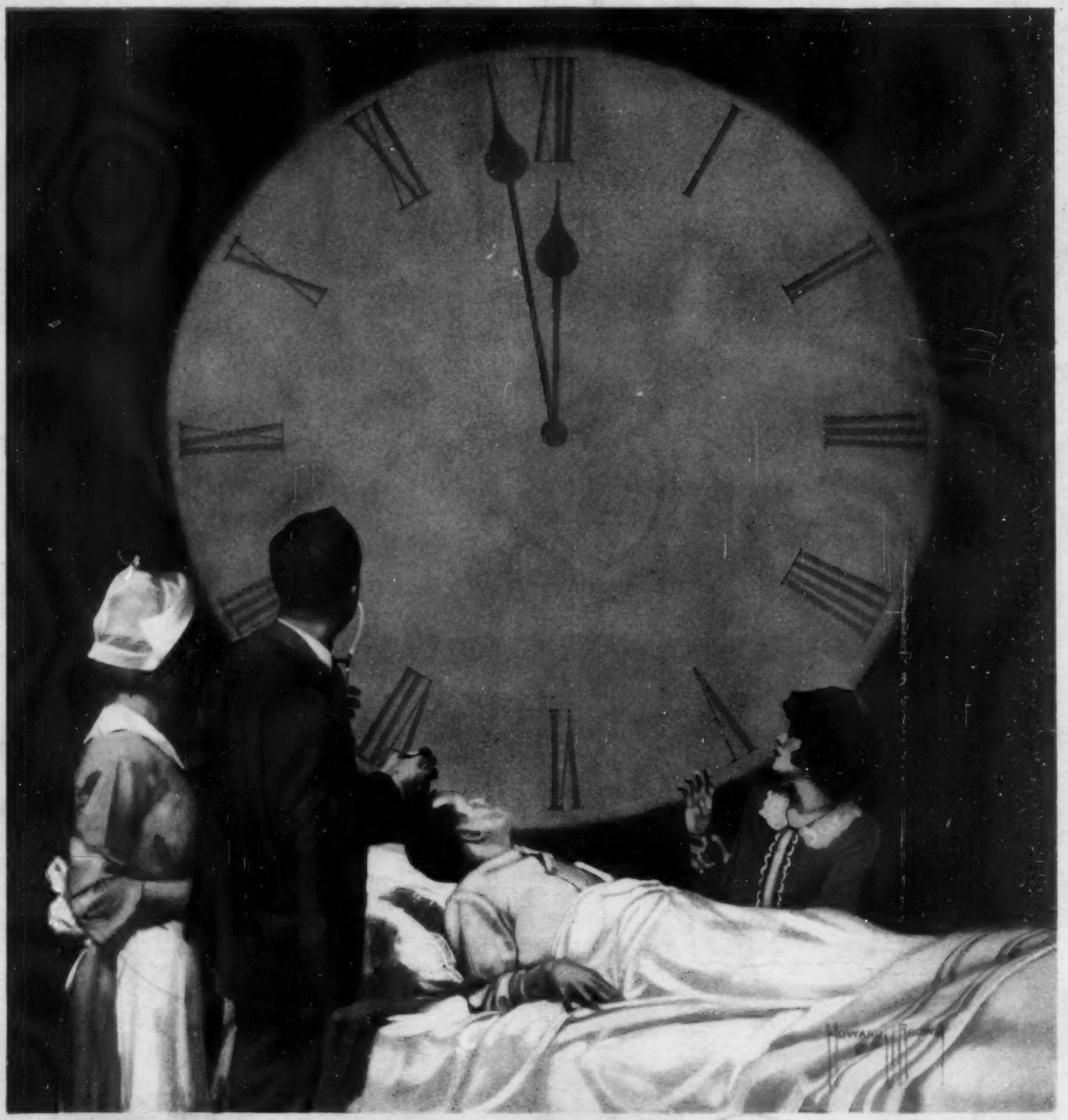

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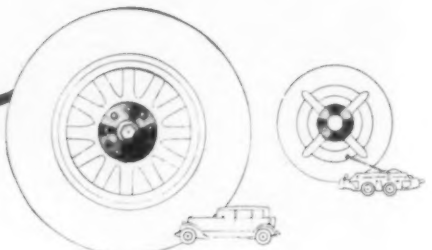

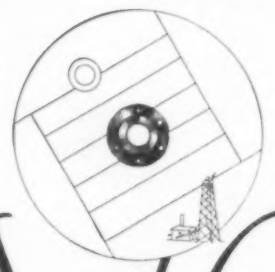

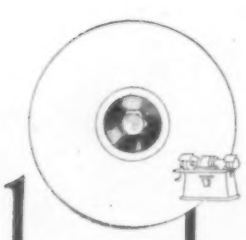

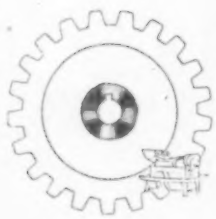

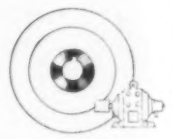

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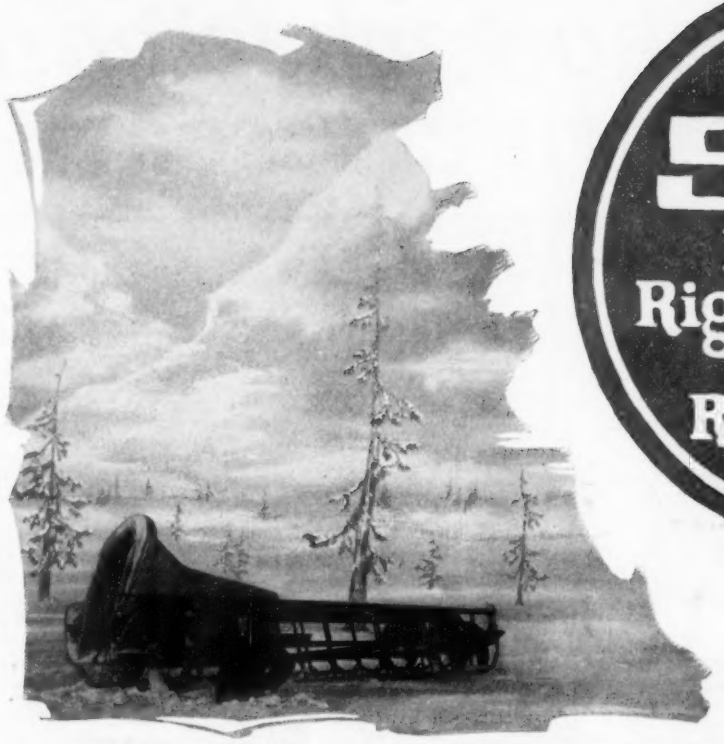

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The place to appreciate Autocar *short wheelbase* is in the driver's seat

The 2 to 3 ton 4 cylinder **Autocar** (wheelbase 114 inches) turning circle is only 38 feet in diameter

Note the short wheelbase

Drawn from a photograph

IF every truck buyer would get into the driver's seat and put an Autocar through his day's work, the advantages of *short wheelbase handiness* would open his eyes.

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MARGERY

THE famous Margery case has been unusually eruptive of late. Many a newspaper editor has found it useful on days when news was light. We understand, even, that a number of theatrical stages have witnessed discussions, more or less acrimonious of the pros and cons of what the newspapers insist on calling our "spook test."

All that, we suppose, is inevitable and unimportant. Eruptions act, so the geologists tell us, as safety valves for volcanoes. They prevent something worse. Maybe this rule applies to other things than volcanoes.

SPOOKS

ANENT the public discussions of the Margery case, there is one kick that we want to get off our chest again. Almost everyone insists upon ascribing to us a desire to investigate spiritualism, defining spiritualism as the idea that the spirits of the dead survive after death and that the alleged phenomena produced by Margery and by other mediums are manifestations of the interest and interference of these departed spirits in our terrestrial affairs.

It is quite true that this interpretation has been put upon the phenomena by some students of the psychic. It is not our interpretation. Our prize was offered solely for the production of *supernormal* phenomena. Such phenomena might be caused by any one of many purely physical forces which might exist. The spiritualistic idea has no more to do with the case than the famous flowers of spring time.

The only job of our Committee is to determine whether the phenomena are real and, if real, whether they are produced by known physical forces or by forces which science does not yet understand. We are not investigating spooks; we are investigating facts.

HONESTY

AWHILE back we said something on this page about an article on vitamines which we had bought and could not pay for because we had lost the author's name. This was an opportunity for the office cynic. He offered to bet us that we would have at least a dozen claims for that waiting check. He was wrong. Evidently all of our readers are honest. Nobody at all has written for the check, not even the lost author to whom it legitimately belongs. We are doubtful whether to be pleased at the general honesty of our family or chagrined because the lost author waited so long that he quit reading the magazine altogether.

EINSTEIN

IN November we began Dr. Rashevsky's series on the Einstein theory. In February the series was interrupted by a change in Dr. Rashevsky's work and residence. Readers who have written us about this have been answered by mail. For the others who may be planning to write us we can save a stamp by saying now that the series will be continued in an early issue.

In This Issue

Must We Rebuild Our Homes?

Yes, says Mr. Calvert Townley, if we wish to use electric heat in our houses and avoid the dirt and inconveniences of coal. Electric heat is already a reality in factories. See what Mr. Townley says about it on page 161.

Autos Destroy Fifty Woolworth Buildings

That is the money damage due to automobile accidents in a year. Someone is killed by auto accidents every thirty-three minutes day and night. Mr. Slauson has been studying this situation for us. He tells what to do about it on page 152.

Does Excitement Keep People Alive?

We have made a study of the hour at which people are most likely to die. The result is a new and interesting idea. People seem to cling to life until after meal time. The interest and excitement of the meal hour keeps them going. Then they give up and die. Read page 149.

How We Are Trying to Make Gold

As this issue goes to press our attempt to crack the atoms of quicksilver and to make gold artificially is in full swing. Photographs of the tubes of fused rock crystal and of the other apparatus that we are using are printed on page 157.

The Longest Distance Ever Measured

Astronomy has produced another marvel. Major Hubble of Mount Wilson Observatory has discovered a nebula that is more than a million light-years away from the earth, which means about a billion billions of miles. Professor Russell describes it on page 165.

MORE THAN ONE HUNDRED PICTURES

Complete table of contents will be found on page 216

For Next Month

Fire! Fire! Fire!

Fire Chief John Kenlon of New York City is a genius and an adventurer. He was shipwrecked once on a desert island but he made a boat out of concrete and sailed away. He has written us an article on how to prevent fires. Thrills plus sound, practical sense. In the April issue, out March 20.

What We Learned from the Eclipse

The great radio opportunity of a century is over. The eclipse of the sun, for which our many collaborators prepared so carefully, came off on schedule. Reports are pouring in. What they tell us will be described in the next issue. There is a preliminary report on page 155 of this issue.

The Story of Steel

Mr. Walker has finished another chapter of his series of articles on the steel industry, the famous articles which were interrupted by his illness. In the next issue he will discuss the manufacture of seamless steel tubing.

Other articles on Radio, The Airplane of the Future, Progress in Astronomy, Volcanoes, Machine-shop Practice, The Smell Organs of Insects, Inventions, Our New Financial Department.

MORE THAN ONE HUNDRED PICTURES

¶ ***If you own a house or run a factory you will want to read what Fire Chief Kenlon says about preventing fires.***

Our circulation department will send you three issues for only one dollar.

RADIO

IN this issue we print the third edition of our list of radio sets which have been examined and approved. We shall not print it again until fall. Few of our readers will be buying new radio equipment during the summer.

Many radio manufacturers are intending, we are told, to bring out new models of their sets during the next four months. Three or four such are already out. During the summer our radio experts will be testing these sets. By the first of September we shall be able to give you a new and revised list of tested receivers for 1926.

The question is, do you want this list? It fills up four pages of the magazine. They are *your* pages, not ours. If you want the radio list next fall write us and say so. If you don't want it and would rather have four pages of other matter in its place, let us know that too.

HORNS

AND while we are on this radio matter, we have another idea that we want to ask you about. Some of our friends have suggested that we ought to publish a list of tested loudspeakers, just as we published the list of complete sets. Many loudspeakers cannot be rated very highly. The public wants, they say, to know the truth.

Do you? Is it worth your while and ours for us to take up the loudspeaker matter during the summer and report to you in the fall? Write and tell us. If you like the magazine, we are going to make you help edit it. Why should we do *all* the work ourselves!

LIGHTNING

SOMEONE has announced that Benjamin Franklin never pulled down the electricity from the sky on a kite string. They say it would have killed him if he had. Nonsense. We will bet a piece of kite string and one old key that anybody who feels like trying it can collect electricity from a kite any time that he feels like it and in just the way that Franklin did. There is no special trick about it and no real danger. It is not lightning that comes down the string. It is merely a part of the static charge from the clouds.

Besides Dr. Franklin said that he did it and he was both an honest man and a scientist who was far in advance of his time.

FLIGHT

WE know that people are beginning to think about aviation as no longer a toy or a weapon but as a useful adjunct to our transportation system. We know that people are reading Professor Klemin's department on commercial flying. They write us and say so.

But what do *you* want to know about commercial aviation, or, for that matter, about any kind of aviation? We believe this is an extremely important subject. We want to give our readers the facts that they need and desire. Write and tell us what we ought to put in Professor Klemin's department. Both he and we will do our best to comply.

The only truck powered by the famous Willys-Knight sleeve-valve engine challenges the world to equal its performance and economy.
$1095
Chassis f. o. b. Detroit

Federal does not make this challenge just to challenge somebody, but to suggest to the serious minded the wisdom of investigating this truck before investing one cent in a new truck of any kind or make.

This truck is the result of years of study of the light delivery requirements of every kind of business. This new Federal fills the needs for a truck that will work in all kinds of weather—under all kinds of loads. A truck that will reduce upkeep costs and increase efficiency. One that will continue to work long after it has paid for itself. Consequently, we make the above honest and sincere declaration.

We urge, whether you are in the market for a truck now or not, to let our local representative demonstrate this truck in your own business without obligation.

UNUSUAL OPPORTUNITY FOR DEALERS IN OPEN TERRITORY

Other Federal Models: 1-Ton $1675; 1½-Ton $2150; 2½-Ton $3200; 3½ to 4-Ton $4200; 5 to 6-Ton $4750; 7-Ton $5000; Light Duty Tractor $3200; Heavy Duty Tractor $4235. These prices are for standard chassis only, in lead—f.o.b. Detroit. Excise tax additional.

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EIGHTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MARCH, 1925

What Minute Will You Die?

By Mary McFadden

THERE is a deep-rooted superstition that the hour of midnight has some mystic significance in human affairs. Deeds of darkness that do not dare to risk the light are supposed to cluster around that witching hour at which graveyards, like the rest of us, begin to yawn.

The curious thing about it is that this superstition turns out to fit a certain set of facts, although, as it happens, it fits them the wrong way around.

At the request of the Scientific American an analysis has been made of the hour at which New Yorkers died in 1923. It is not true, as the mystics would have us believe, that most of them died at midnight. On the contrary *fewer* people in New York City die at that supposedly mysterious hour than at any other hour of the twenty-four.

Mark Twain is reported to have said that a careful study of statistics proved that the most dangerous place in the world was bed, for more people died there than anywhere else. If this be good logic—which we are far from affirming—one would have to conclude that the secret hour when one day changes to the next is the most healthful hour in all the day.

Is it that persons who are sick enough to die cling a little longer to the vital spark so that they can see the clock begin another round? Or is it that some mysterious influence of air or tides, or sun or moon or stars, favors life at some hours and hastens death at others?

No one knows. The data gathered for this investigation permit some guesses, to which we will come in a moment.

What They Thought of Influenza

The belief in some such malign or beneficial influence of tide or time or stars was a foundation stone of ancient medicine. Traces of it survive. The special malignity of "night air" is a superstition not yet entirely routed from the minds of men. We call one of our worst bacterial scourges "influenza," which word means, quite obviously, nothing but "influence"; some mysterious effect or effluvium which the ancient doctors no more knew how to label than they knew how to combat it.

Thoughtful men are impressed always with the mystery of things. In the beginning men sat by the sea and wondered what was on the other side of it. When they began, very slowly, to discover that across the sea lay other lands their wonder turned to the mystery of the sea itself. What great breathing monster lurked somewhere in its depths and raised that daily ebb and swell which mariners have learned to call the tide? Many a great philosopher puzzled his brain over that mysterious heartbeat of the waters before some one hit on the secret that the cause lay in the attraction of the moon.

And confronted with that greater mystery, the enigma of death, men turned, as was quite natural, to the ebb and flow of oceans. The dying died, they said, at the outward turn of the tide.

People Stay Alive for Meals

To settle the old question of the exact hour of the twenty-four at which a sick person is most likely to give up and die, the Scientific American asked Miss McFadden to study the records of deaths in New York City for a whole year. She has found some remarkable and unexpected results.

Doctors commonly believe that sick people are weakest in the early hours of the morning; that death is more likely in the "darkest hour before the dawn." It turns out that this is partly true.

But there are some more remarkable results. For example, sick people seem to stay alive until after meal time—not their meal time, but the meal time of the persons around them.

Miss McFadden believes that the interest and excitement aroused by this event urges a dying man to cling fast a little longer to his spark of life. No one likes to quit a world where anything is happening.

The currency of this idea—for there can be no doubt that it is still current in the minds of a majority of people—must be credited to literature not to science nor to the fringe of science that men call magic or occultism. The man who gave it currency was Charles Dickens. Mr. Peggotty says in "David Copperfield," "People can't die along the coast except when the tide's pretty nigh out. They can't be born unless it's pretty nigh in—not properly born 'til flood."

But this is not scientific evidence. What are the real facts about the hour of death? Does death really hover closer as the ebb begins? Or is there truth in that equally common superstition—common even among the scientifically trained physicians and nurses of the hospitals—that death is more to be feared in the early hours of the morning than at other times, that patients who are known to be in danger will bear closer watching during those "darkest hours" that come just before the dawn?

Prior to the present investigation made for the Scientific American two physicians have made more or less comprehensive analyses of the hour of death in American cities. In 1890 Dr. John Francis Burns analyzed the time of 15,000 deaths and in 1901 Dr. Howard D. Marsh studied the records of some 36,000 deaths, including 23,439 deaths in his assembled figures.

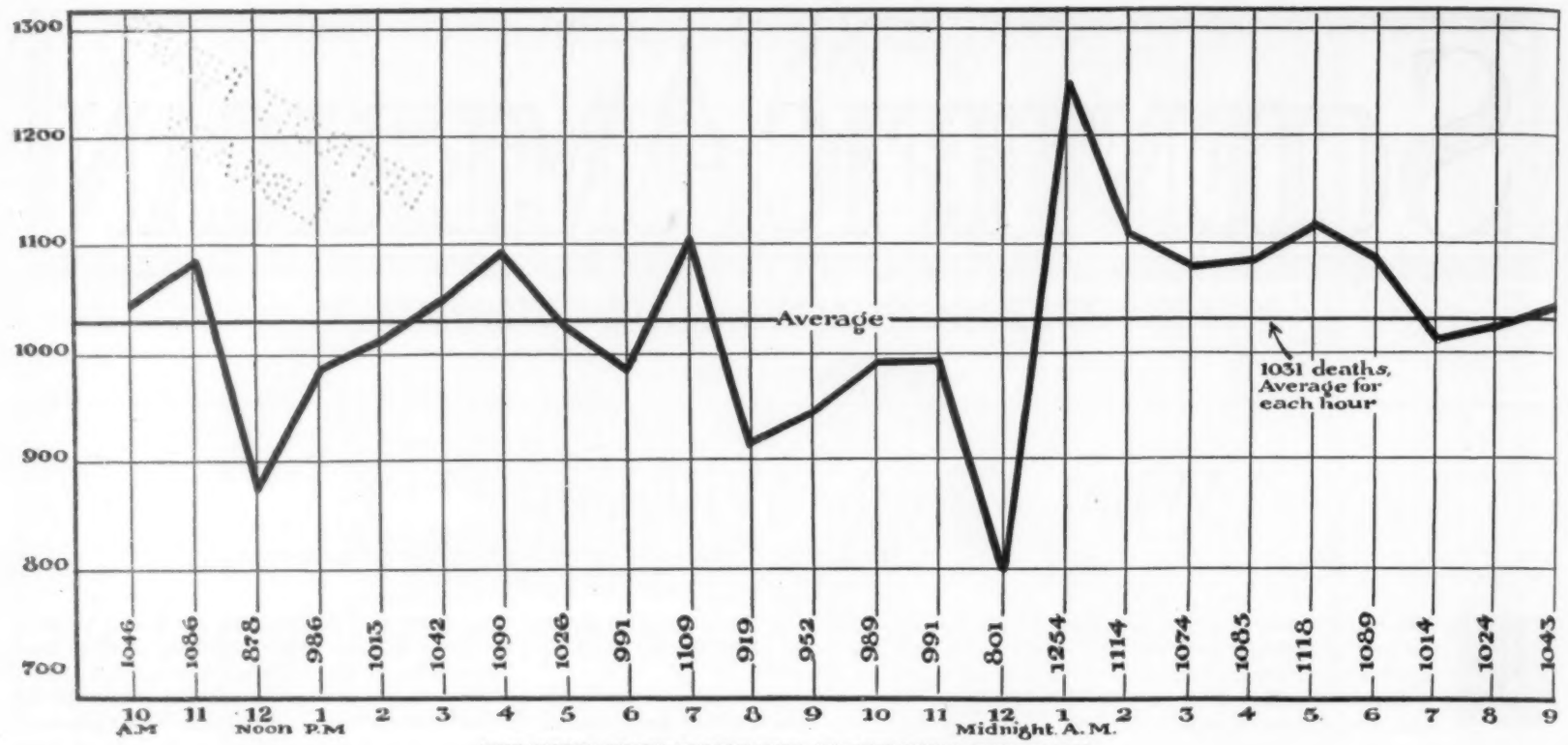
In addition to these two important investigations Dr. Finlayson had studied the records of some 13,000 deaths in the city of Glasgow, Scotland, in 1865; Dr. Schneider had made a partial analysis of some 57,000 deaths in Berlin; Dr. C. F. Beadles had studied the records of approximately 5,000 deaths in the Colney Hatch Insane Asylum; Dr. Berens had analyzed 1,000 deaths in Philadelphia, and Dr. Oscar J. Coskery had made a careful comparative study of 400 deaths and of the records of temperature, humidity and other atmospheric factors at the hours when these deaths occurred.

Is Death a Matter of Chance?

The net result of this considerable body of statistical effort was absolutely nothing. Dr. Coskery, whose studies were the most comprehensive as to possible causes of death, although carried out on a comparatively small number of cases, was at some pains to prove from his data that there is nothing to prove; namely, that the hour of death is determined merely by chance. As many persons die at one hour of the twenty-four, Dr. Coskery concluded, as at any other.

On the other hand, Dr. Marsh's data indicated that death really was more likely to occur in the early morning hours than in the daytime or in the early part of the night. He accepted the idea that human vitality is lowest shortly after midnight. If death threatens at all it is more likely then. But Dr. Burns, with the set of figures most nearly comparable to Dr. Marsh's in number and competence of analysis, disagreed absolutely with this conclusion. He could find, in his 15,000 cases, no evidence that early morning deaths were more common than those in the afternoon.

Here the matter stood. Other investigations were similarly inconclusive. Physicians continued to believe, as they undoubtedly still do believe, that the hours just after midnight were the dangerous ones. But Dr. Burns and Dr. Coskery testified to the contrary. The Scientific American determined to make another try for the truth.



THE HOURS WHEN PEOPLE DIED IN NEW YORK CITY IN 1923

This curve summarizes the hour of death for 24,742 natural deaths that occurred in the Borough of Manhattan during 1923. The figures just above the bottom line of the drawing give the actual numbers of deaths. These figures, plotted, make the curve. The meaning of the curve is discussed in the text

In the year 1923 there were reported from the Borough of Manhattan, New York City, a total of 31,384 deaths. The certificates recording these deaths are filed, bound up into books, in the vaults of the Bureau of Vital Statistics of the New York Board of Health. Through the much appreciated courtesy of Dr. William H. Guilfoy, the efficient Registrar of this Bureau, these certificates were made available to the writer and her assistants, as representatives of the Scientific American.

Of the total number of deaths in Manhattan in 1923 a total of 2,649 were violent deaths—murders, suicides, fatal accidents, heat prostrations and the like. Also, there were some four thousand deaths of children under one year of age, deaths which could not be expected to show the same relations to the hour of the day as might prevail for adults and older children.

Eliminating these two groups of deaths and also some individual cases where the information was incomplete or uncertain, there were left 24,742 deaths which were analyzed for this investigation. In each case the hour of death, as set down on the certificate by the attending physician of the hospital authorities, was recorded. These records have been summarized. The results are given in graphic form, as well as numerically, in the curve printed on this page.

This curve is indeed a remarkable document. First of all, it is apparent that the common opinion of the medical profession is right, at least for the deaths in Manhattan during 1923. It is really true that more people do die in the early morning hours than at other times during the day.

There has been added to the curve, for the sake of easy comparison, a horizontal line indicating the average number of deaths during one hour of a twenty-four hour day. Expressed numerically, this average is 1,031 deaths.

The Witching Hour of Twelve

If death occurred by pure accident, so that as many deaths happened, on the average, at one time of the day as at another, all the points of the curve would lie on this horizontal line. That is, there would be no curve. This was Dr. Coskery's idea, more or less supported by Dr. Burns. With enough deaths so that individual and accidental variations were submerged in the averages, there would be no determinable tendency, they believed, for the deaths to cluster around certain hours and to shun certain other hours.

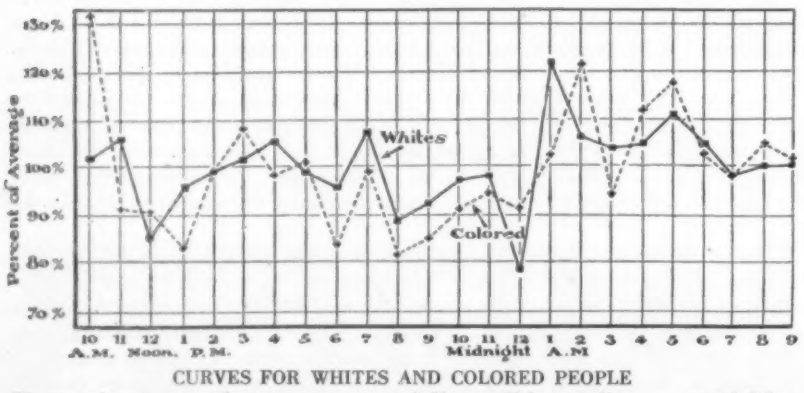
It is apparent at a glance that this is wrong. There *is* a curve. The average number of deaths does rise and fall from one hour of the day to another.

And there is a clearly determinable excess of deaths in the hours between 1:00 A.M. and 6:00 A.M. Those points on the curve which lie above the "average" line indicate, you remember, hours at which *more* than the average number of deaths were recorded. Points which lie below the average line indicate hours at which the numbers of deaths were *less* than the average. The excess of deaths in the early morning, between one and six, is made up, the curve shows by a deficiency of deaths in the early afternoon, between noon and 2:00 P.M., and by another deficiency between 8:00 P.M. and midnight.

That is to say, the most healthful parts of the day —or, at least, the parts of the day when you are least likely to die—are the hours between noon and 2:00 P.M. and the hours after supper and before 1:00 A.M.

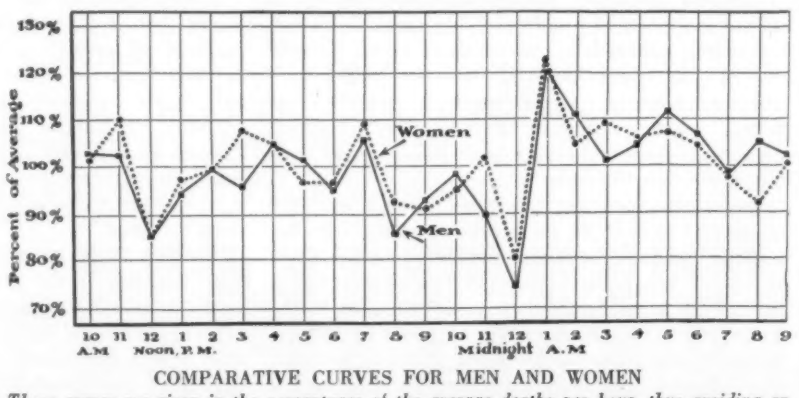
This is interesting, but a still more remarkable indication of the curves is the extraordinary deficiency of deaths at the hours of noon and, more markedly still, the hour of midnight. Fewer deaths occur at these two hours than at any others. The "witching hour" of twelve must be controlled by kindly and beneficent witches, for those are the hours when the Angel of Death is least likely to carry some poor human away. And the witchery, whatever it may be, commonly ascribed to the midnight stroke of twelve is shared, it appears, by its much more prosaic brother of the daylight noon.

It is inevitable that we begin to speculate about



CURVES FOR WHITES AND COLORED PEOPLE

The variations between the two curves are probably too slight to indicate any racial differences, especially since the number of deaths among colored people was relatively small



COMPARATIVE CURVES FOR MEN AND WOMEN

These curves are given in the percentages of the average deaths per hour, thus avoiding an error due to the fact that more men than women died in Manhattan in 1923

A PAINTING THAT HAS TOUCHED A MILLION HEARTS

Few works of art have had a wider public than the famous painting of "The Doctor," by Sir Luke Fildes. It is easy to see why. The hour when death is closest to our dear ones is an hour we never forget

why these things are so. There is no reason to ascribe any death-repelling power to the number twelve. The fact that the hands of our clocks stand together at the top of the dial twice in each twenty-four hours cannot be believed to have any fateful power over life and death. And the occurrence of a minimum of deaths at *both* noon and midnight seems to dispose of the idea that some stimulating effect of an overhead sun—or, for that matter, of an underneath sun shining on China on the other side of the earth—might keep sick people temporarily alive.

What *is* the answer?

One cannot be sure, but as likely as not it is meal time!

Note on the curve that there are small decreases in the number of deaths at 6:00 P.M. and again at 7:00 A.M. Note that the decreases at noon and at midnight are followed by considerable increases in the later afternoon and, more rapidly in this case, at 1:00 A.M. These facts may be significant. What is it that happens in the sickroom or the hospital at 7:00 A.M., at noon, at 6:00 P.M. and at midnight which something may help to keep the dying alive for another hour or two?

Dying Men Think of Meals

We can think of nothing except a meal. These are the hours at which, in most cases, the patients and other people about them take their food. The midnight lunch is as characteristic of the sickroom as is the noonday meal for the rest of us.

There is no reason, of course, to believe that it is food given to the patient which accomplishes this temporary defeat of death. What food may or may not do to the bodily machinery of a dying man depends, of course, upon what is wrong with him and upon the treatment which the physician has prescribed. In most cases, indeed, the food is itself a part of the treatment. Some sick people will be saved by food; others it will kill. So it cannot be the *patient's* meal time that keeps death waiting at the door.

But what can any one else's meal time have to do with the sick man's death?

Dawn Seems So Far Away

Simply this. It arouses his interest. When the partnership of bodily organs that we call life is about to dissolve there is commonly only one thing that holds it together as long as possible. That is the will to live; the interest of the patient in life. When this interest is gone, when this will to stay alive at all costs no longer dominates the sinking brain, then is death's opportunity. The dying stay alive not from hour to hour but from event to event. In the morning they wait for the interest and excitement of noon. Then it is that the nurses are changed or the meal is brought in or one member of the family replaces another one so that the first watcher can have rest and food. In the sickroom little things like this are happenings of importance. They are cracks in the monotony; cracks by which the dying fingers may hold, a little longer, their slackening grip on life.

And in the evening there is midnight to look forward to. Something will happen then, if that something is no more than the beginning of another round of the clock, another day to be torn off from the calendar. No one wants to die until that turning point of one day's time is reached. Hence, perhaps, the remarkable decrease of deaths at midnight, preceded, it will be noticed, by a similar although smaller decrease during the several preceding hours.

Midnight passed, there is nothing else to look forward to until dawn and dawn seems so far, so far, away. It is not that *vitality* is at a lower ebb in these hours between the midnight and the dawn, it is that *interest* is at its lowest ebb. Nothing happens. The night nurse dozes in her chair. Sounds of the city are still. Everything is peaceful, but it is not peace that helps us cling to life. Six hours of ennui must be faced and six hours seems too much. The sick man drops off, perhaps, for a little nap and his nap turns out to be forever.

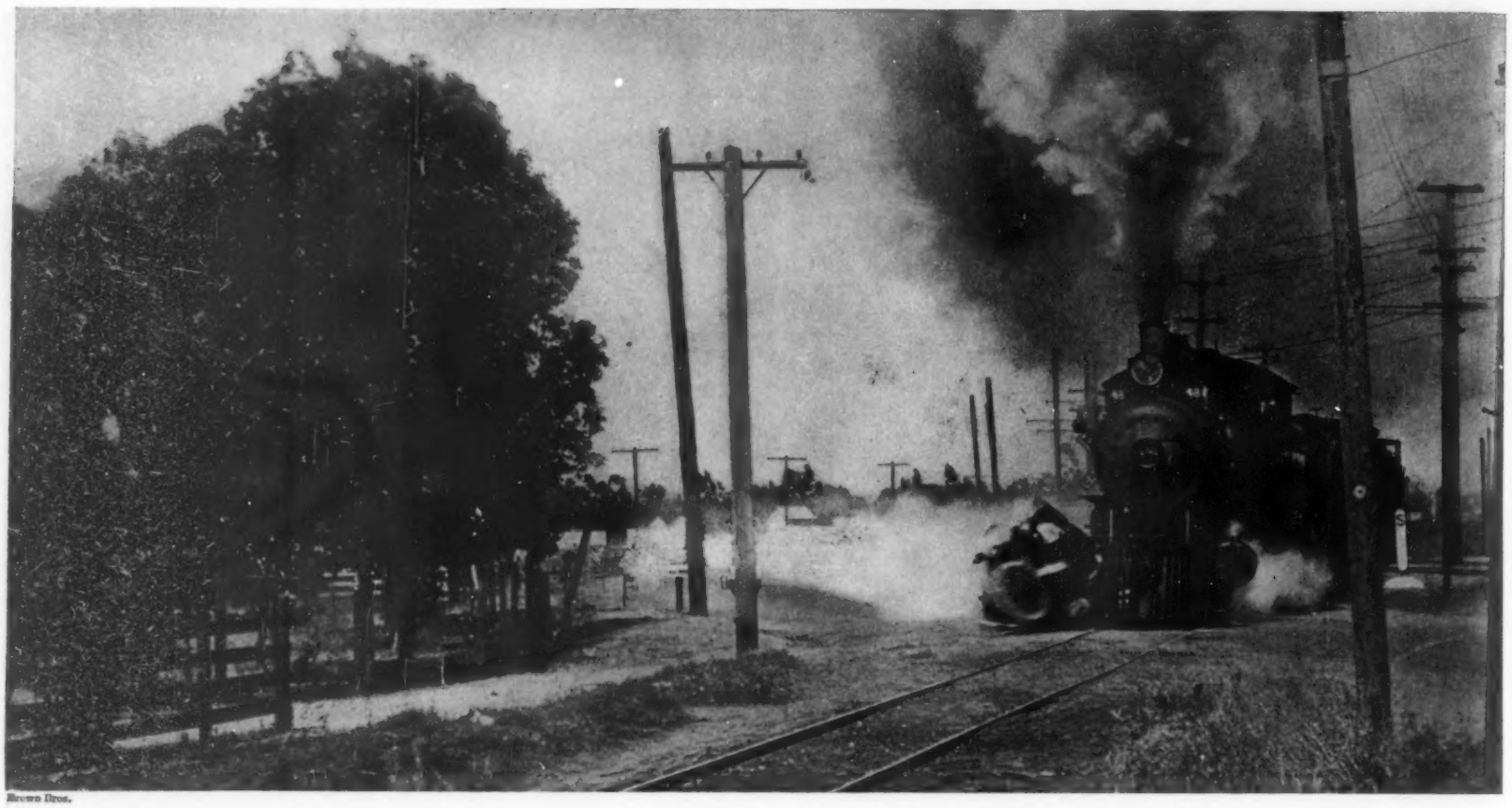
How true is all this? No one knows. Here are the figures. They, at least, are certain. Each reader may judge for himself whether the interpretation we have advanced is a true one or whether it is a bit of imaginative moonshine. But even moonshine, remember, is not to be despised as a guide when you have no other light.

Excitement Keeps Them Alive

One caution it may be well to state. Some physicians have urged that the apparent meaning of these figures is not real, that it is due to an error in the data. It is possible, they suggest, that the apparent decrease of deaths at midnight (for example) may be an illusion due to the fact that deaths which actually occur then are not discovered until an hour or so later because the night watcher is absent or asleep. This is just possible. But in modern hospitals and by modern bedsides the dying are seldom left unwatched, even for an hour. This criticism might have been quite valid if urged against the results of Dr. Finlayson in 1865 when hospitals were less efficient. It has little weight in 1923 and in the city which possesses, it is admitted, the best health and hospital services in all the world.

No, that explanation cannot be granted. It is reasonably certain, we believe, that people do tend to stay alive until after midnight and to die at 1:00 A.M. About the cause we are less certain. But we like the idea that it is the happenings about them which preserve for a little their grips on life.

Happenings mean excitement. Maybe excitement does not kill people. Maybe it keeps them alive.



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The Auto's Toll of Lives

How Can We Revise Our Traffic Laws to Make the Highways Safer?

By H. W. Slauson, M. E.

STAND on the corner of Fifth Avenue and Forty-second Street, or any other similar city cross road in the country, and at the end of every fifteen minutes of normal traffic, you will have seen one car which was the cause of a death last year.

This is only another way of saying that there was a motor-vehicle death for every 938 automobiles and motor trucks registered in the United States in 1923. Only about one in twenty-five automobile accidents result fatally, for the total number of injuries from this source last year exceeded the half million mark. As President Coolidge has said, if these years' total of accidents "were concentrated into one calamity, we would shudder at the tremendous catastrophe"; and the seriousness of the figures is by no means reduced, if we assume that more than fifty percent of such accidents were due directly to the carelessness of the pedestrian. When the individual argues the right of way with a heaving moving mass, it is might that makes right. The pedestrian is bound to suffer, with the result that the automobile will always be blamed as having "caused" these accidents, even though the man, woman or child might deliberately court suicide by stepping directly in front of an oncoming vehicle.

Chickens Crossing the Road

Some pedestrians, evidently, are direct descendants of the original chicken which first fluttered across the road in front of our great-grandfather's ox cart; but if this be so, on the other hand, the blood of Jehu must course through the veins of many of our automobile drivers.

However, bad as conditions are, they have been improving steadily ever since the advent of the motor car. Of course, the total number of accidents has increased year by year, but not in the same proportion as the increase in the number of automobiles in use. For example, during the past six years, the number of highway accidents due to the motor vehicle has increased eighty percent; but in that same period, the number of automobiles in use has grown from 6,000,000 to 15,000,000, or an increase of 250 percent. This means that the deaths per thousand automobiles in use has been reduced from 1.9 in 1917, to 1.06 in 1923. Or, to put it another way, six years ago there was one death occasioned by every 525 automobiles, as against the one death at present for nearly each thousand automobiles in use.

Secretary of Commerce Hoover has estimated that the total cost to the country occasioned by these automobile deaths and accidents exceeds one half billion dollars annually. Therefore, from the economic as well as from the humanitarian standpoint, stringent measures must be taken to protect the automobilists and the pedestrians from themselves and from each other.

Engineering, scientific and psychological problems are involved. All of them are highly complicated by considerations of the "rights" of individuals and of the mass of the people.

Ignorance Is No Defense

It is unfortunate that there are not more engineers and scientists in our law-making bodies. The tremendous mechanical success of the automobile has been made possible very largely by standardization. This has been reached through conferences of chief engineers and designers, by the adoption of standards which suit the *majority* of manufacturers, rather than any individual one.

Our motorcar laws, on the other hand, have been written apparently from just the opposite viewpoint. Each state, in order to maintain its individuality and to assert its heritage of states' rights, seems to go out of its way to make its motor-vehicle laws as different from those of its neighbors as is possible.

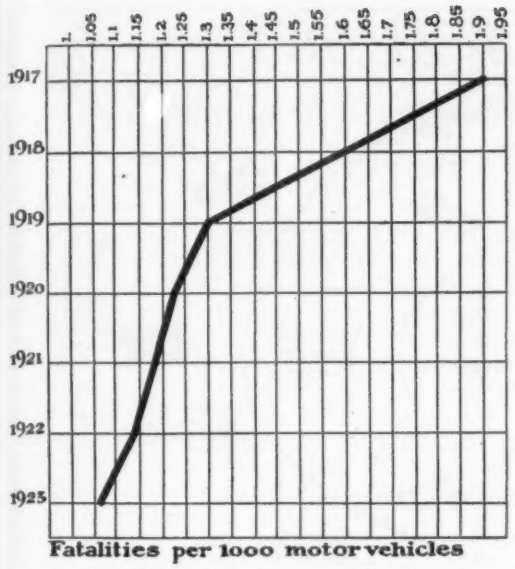
In some states, a minor may drive a car of any size or weight. In others, a license and examination

Fewer and Better Laws

This, says Mr. Slauson, is the only sane solution for the ever-growing problem of traffic control.

The automobile is becoming too dangerous to have around unless we can make it safer. The threat increases with every thousand new cars that we crowd onto our streets. Everyone knows, by now, that this problem must be faced and faced soon.

Mr. Slauson represented the Scientific American at Secretary Hoover's recent conference on street and highway traffic. This article presents some of his conclusions. Later articles by him will deal, sanely, fearlessly and helpfully—with such problems as insurance, brake inspection, the use of highways by trucks, parking provisions and the like.



ACCIDENTS ARE ON THE DECREASE

A chart showing that while the total number of fatal accidents has increased, the number of accidents per thousand cars in use has shown a steady decrease

is required from every operator. Some give traffic approaching from the right-hand side the right of way; others require a stop at every railroad grade crossing; some compel the use of rear-view mirrors; still others prohibit the use of a searchlight or spotlight unless its movement is restricted to the downward position.

The resulting chaos which confronts the driver who has occasion to cross several state boundary lines may well be imagined. He *tries* to conform to every highway and traffic law, but he may be "called down" for such a variety of seemingly minor infractions that he is likely soon to lose respect for *all* motor vehicle laws. The enforcement officers of neighboring states are also confronted with a difficult situation, for, while the theory that "ignorance of the law is no defense" may be applied, the purpose of the law should be to make compliance and observance easy and almost automatic, rather than as difficult as the solution of the most complicated cross-word puzzle.

But Secretary of Commerce Hoover has justified his engineering training. Realizing the extent to which highway safety depends upon a greater standardization of state, county and city motor-vehicle laws, he has formed a council of national scope to deal with the situation. The mass of highway vehicles in this country operate under a variety of conditions. It is only by an interchange of ideas, originating in every part of the United States, that any attempt can be made to correlate and standardize the formation, operation and enforcement of such laws.

Consequently, this National Highway Safety Council which met in Washington a few weeks ago, was composed of state highway commissioners, railroad men, automobile manufacturers, delegates from Drivers and Motor Car Owners Association, city engineers and police officers from every section of the country. The recommendations which were evolved, after careful consideration by a marvelously efficient system of committee organization, form the nucleus of ideal laws and methods of enforcement. These have been submitted to the lawmaking bodies of every state and form a working basis for the first serious attempt at a standardization and unification which should result in a marked decrease of highway accidents.

Engineers Made Into Nervous Wrecks

It may be asked why the railroads were represented at a conference dealing entirely with highway safety inasmuch as railroad trains run upon their own right of way. But trains must cross highways —at least some highways—at grade, and statistics show that a goodly percentage of the deaths, attributed to the automobile have been occasioned when the driver endeavors to dispute the right of way of a railroad train. Nor is the damage confined entirely to the vehicle and its occupants, for railroad managers can show some of their most valued engineers made nervous wrecks overnight because of the shock occasioned by casualties at grade crossings, casualties which could have been prevented had the driver of the car or truck exercised due precaution. And speaking of trucks, it is worthy of note that many railroad trains, some carrying passengers, have been derailed and serious accidents caused, by striking a heavily loaded motor vehicle.

It can easily be shown that many of these accidents occur at grade crossings at which the view of the oncoming train is obstructed in one or both directions. Figures have indicated, however, that even a larger percentage of grade-crossing accidents take place at those open crossings where the oncoming train may be seen a half mile or more away. The reason for this is probably due to the fact that the motorist feels that he may easily beat the train to the crossing. Either through a miscalculation of its speed or by inexpert handling of his car, he reaches the track at the same time as the train approaches the highway.

We do not know, exactly, how many trees are used every year to be converted into lumber to replace the railroad grade crossing gates which are smashed annually by approaching motor vehicles. The "gate crasher" seems to be increasing instead of decreasing among the motoring fraternity and strenuous efforts will need to be taken to protect him from himself.

The above facts were emphasized so strongly at Secretary Hoover's conference, that recommendations were made empowering the State Highway Commission, the Public Service Commission and other bodies serving such a purpose, to designate certain unpro-

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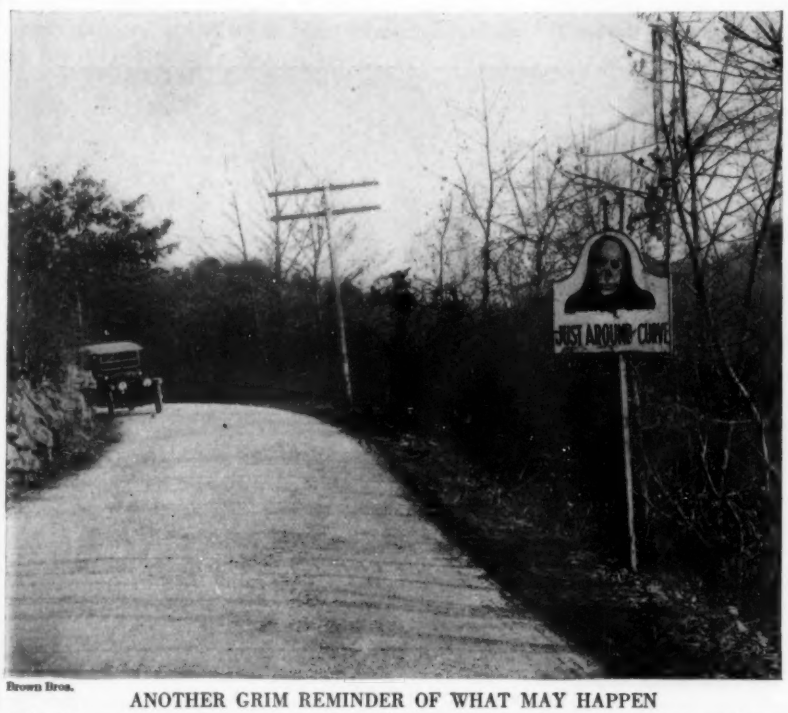
A STRIKING OBJECT LESSON

Surely a driver will think twice before trying to beat a train to the crossing when confronted by this evidence of some previous driver's foolhardiness



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ANOTHER GRIM REMINDER OF WHAT MAY HAPPEN

This sign, erected on a mountain road, effectively warns the driver of a speeding car that a dangerous curve will be encountered just around the corner

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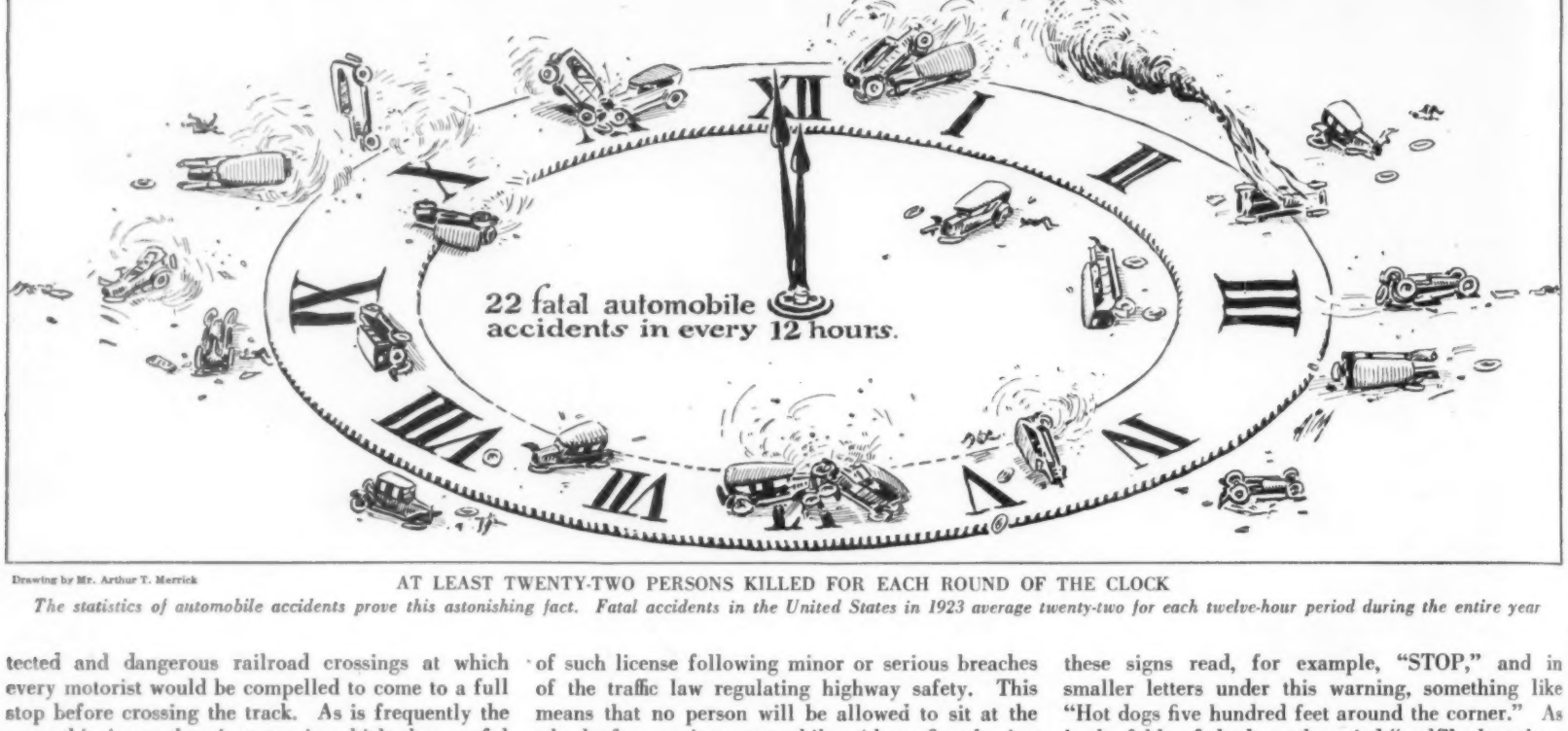
THE HAPPY HUNTING GROUND OF THE JAY WALKER

Despite the signal towers which have been erected on Fifth Avenue, New York, policemen are still needed to keep people from crossing the street when they should not



Drawing by Mr. Arthur T. Merrick

AT LEAST TWENTY-TWO PERSONS KILLED FOR EACH ROUND OF THE CLOCK

The statistics of automobile accidents prove this astonishing fact. Fatal accidents in the United States in 1923 average twenty-two for each twelve-hour period during the entire year

tected and dangerous railroad crossings at which every motorist would be compelled to come to a full stop before crossing the track. As is frequently the case, this is another instance in which the careful and law abiding driver must suffer for the sins of the careless operator. But this is true, too, with the speed laws which, while intended primarily to curb the reckless driver, apply to the careful and expert owner as well.

Education of school children as well as of other pedestrians, efficient regulations governing one way streets, parking and general city traffic conditions, proper control of blinding lights and adequate enforcement of fewer but more drastic laws—all these represent some of the ways in which the present terrific toll of highway accidents will be reduced. Each phase is worthy of separate discussion of its own.

As an indication, however, of the extent of the investigation and the far-reaching consequences of the recommendations to be followed, it is interesting to observe that the Conference strongly favors the licensing and examination of every individual car driver, with the suspension or absolute revocation of such license following minor or serious breaches of the traffic law regulating highway safety. This means that no person will be allowed to sit at the wheel of a moving automobile without first having passed a physical and mental examination as well as a test for driving ability.

Everyone Must Help

One of the requirements recommended in the mental test is the ability to read English. At first sight this may seem to be a rather severe requirement, but when we remember the number of warning signs necessary to control the efficiency and safety of traffic, a knowledge of the English language is seen to be absolutely necessary. A driver who cannot understand the warnings of a detour, railroad crossing or a sharp curve, represents a menace to others as well as to himself.

In connection with the use of warning signs, one of the most constructive recommendations which has yet been made is that which attempts to abolish the advertising signs made to imitate a road direction or other warning signal, a type of which is all too frequent on our main traveled highway. Some of these signs read, for example, "STOP," and in smaller letters under this warning, something like "Hot dogs five hundred feet around the corner." As in the fable of the boy who cried "wolf" when there was none, the principal danger of such signs lies in the liability that the average motorist will grow so used to them that he ignores the real danger signs when they appear.

These comments indicate only a few of the strenuous efforts which must be taken to curb and control the fast growing motor traffic of our city and country highways. The motor vehicle is too efficient, too valuable, too necessary an instrument of transportation, for it to be allowed to be guilty of even ten percent of the deaths and accidents with which it is charged.

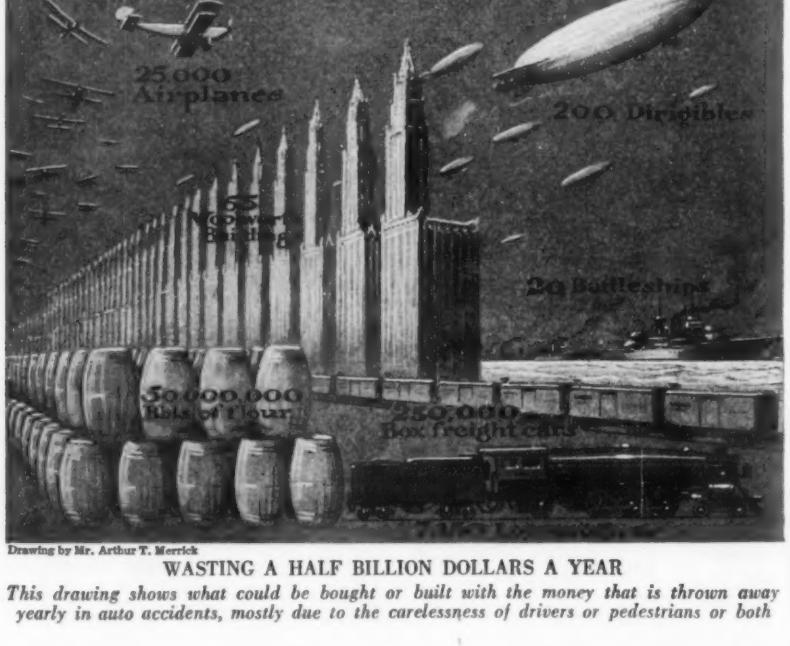
Owners, drivers, manufacturers, state and city officials, must continue this cooperation to the point where the efficiency of the modern motor car and the ability to use it will be combined with a very radical decrease in the number of avoidable as well as the so-called "unavoidable" accidents and deaths which are occurring in alarming numbers nowadays on our highways.

Number of Motor vehicle deaths in 1917 - 9,184
Number of Motor vehicle deaths in 1923 16,000
Motor vehicles in use in 1923 15,092,177

Drawing by Mr. Arthur T. Merrick

COMPARATIVE INCREASES IN CAR AND IN FATALITIES

During the period between 1917 and 1923 there was an increase in motor vehicle deaths of 80 percent. But during the same period the number of vehicles in use increased 250 percent



Drawing by Mr. Arthur T. Merrick

WASTING A HALF BILLION DOLLARS A YEAR

This drawing shows what could be bought or built with the money that is thrown away yearly in auto accidents, mostly due to the carelessness of drivers or pedestrians or both

"The Best Observed Eclipse in History"

A Preliminary Report of What Was Learned on January Twenty-fourth, Including the Results of the Scientific American's Observing Party

THE title of this article is a quotation from a remark by one of America's distinguished astronomers immediately after the eclipse. In spite of gloomy predictions of unfavorable weather and in spite of the relatively early hour of the morning at which the great event came off, the eclipse was distinctly a success.

In order to catch the presses for this issue, these paragraphs are being written within thirty-six hours after the totality was over. Most of the observations are not yet reduced to order; most of the photographic plates are still undeveloped. Nevertheless, it is already possible to say that American scientific men—ably assisted by the weather—have again distinguished themselves.

The results which we feel sure have been obtained include: the color photographs of the corona, a more precise timing of the eclipse than ever accomplished before, a better measure of the edges of the shadow on the ground, better observations of the mysterious shadow bands than have been secured at any previous eclipse (it is possible that we have managed, even, to get photographs of these remarkable bands), artists' sketches of the coronal colors, the first complete motion picture record of an entire eclipse, accurate measurements of the effect of the eclipse on the temperature of the air (the so-called "cold wave" of the eclipse shadow) and a wealth of photographs both of the corona and of the spectra, including the so-called "flash" spectrum which shows for an instant just before and just after the total part of the eclipse.

Last, but not least, it is reasonably certain that the cooperation between the radio engineers headed by Mr. Greenleaf W. Pickard, the American Radio Relay League and the broadcasting stations and thousands of radio listeners who have been good enough to join the Scientific American radio tests, has resulted in some remarkable data concerning the effect of the eclipse on radio and the theories of radio transmission.

The greatest surprise in the eclipse was the weather. Predictions indicated a very poor chance of clear skies. The time of the year was wrong, the time of the day was wrong. But, for once, the weather sprite was on the side of science. On the twenty-second of January came a cold snap followed by cloudless skies and bright clear air. On the morning of the eclipse the 7:00 o'clock weather report that came over the special telegraph wires from the observing stations indicated cloudy conditions at several stations. But this was temporary. By a few minutes before the fateful six minutes after nine the skies were clear everywhere east of Buffalo. The eclipse was observed at all eastern stations under practically perfect conditions, the only obstacle being a slight, high haze at a few of the observing stations.

The Scientific American party at Easthampton, nearly at the eastern end of Long Island, had a scare an hour or two before the eclipse. The sky had been clear all night. Everything looked favorable. But at about 6:30 in the morning, just as the observers were assembling for final rehearsals and instructions, a bank of thin clouds began to drift up from the west. Rehearsals were conducted with only one eye on the instruments. Everybody's other eye was on that threatening cloud bank advancing so inexorably from the western horizon.

At 8:00 o'clock it was time to send out the Easthampton weather report to the other observatories. The chief of our party took his courage in hand and became an optimist. He sent a message "partly cloudy but clearing; conditions favorable." At 8:40, only thirty minutes ahead of the eclipse, it was still partly cloudy but we refused to change the weather report. "Holding the thought" might help. Anyway it would do no harm.

Our optimism was justified. By ten minutes ahead of the eclipse the sky was clear. The great spectacle was not marred by so much as a single wisp of cloud.

Similar conditions prevailed at New Haven, where Professor E. W. Brown, President of the American Astronomical Society and official general of the astronomical army, had assembled the largest single congregation of astronomical and physical talent. Middletown, Poughkeepsie and Ithaca, as well as many smaller observatories within the shadow path had equally good luck.

Planning for the Next Eclipse

For the next total eclipse of the sun that will be visible in New York and New England we shall have to wait until 2024. Not even the Scientific American is optimistic enough to be planning now for that one.

But there will be a total eclipse next year, on January 14, 1926, to be exact. It will be visible in parts of Eastern Africa, Sumatra, Borneo and the Philippine Islands. We have already begun plans for repeating at this next eclipse the radio investigations and the color photography of the corona.

We have learned how to do these things. Now we can do them better. And ten months is none too long a time to get our plans in shape.

As these paragraphs are written it is too soon to discuss results or to decide what particular observation is likely to prove the most valuable to science or the most interesting to the public. By the time that our next month's issue goes to press we will have more facts at hand and we shall give you then a more complete report.

At present it seems that at least two results are of exceptional importance. One of these is the making of a color photograph of the corona. The Scientific American is proud that in the friendly rivalry of observation this particular bit of accomplishment fell to its own expedition.

Two members of our party, Mr. Edward R. Hewitt and Mr. J. Wesley Allison, attempted, by somewhat different methods, to secure an actual photographic record of the corona in its original colors. Both attempts were successful.

If difficulties of reproduction can be overcome, one of these remarkable photographs will adorn the cover of the next issue of the Scientific American.

Another outstanding accomplishment of the scientific attack on this eclipse is the precise timing of the beginning of totality. This was accomplished by the use of the telegraph and telephone lines supplied by the American Telegraph and Telephone Company. As a contribution to science, this company provided two complete wire circuits connecting the observing stations at Buffalo, Ithaca, Poughkeepsie, New Haven, Middletown and Easthampton.

Unfortunately the weather was cloudy at Buffalo, but at each of the other stations a telegraph signal was sent over the wire at the instant at which the eclipse became total at that station. These time signals were recorded automatically on the astronomical clock at the New Haven Observatory and also on a special, extremely accurate chronograph installed at the laboratories of the telephone company at West Street in New York City. The result is an almost perfect time record for the passage of the eclipse across the country, a record which will enable, it is believed, a substantial improvement in the best present calculations for the path and motions of the moon.

As this is written it has been announced by Professor Brown that the eclipse appears to have been approximately four seconds late as compared with the advance calculations. This figure is subject, however, to some alteration when the exact time-lags and other corrections shall have been computed and applied. The final figure, when known, will probably permit the advance calculation of future eclipses with still greater accuracy than was attained for this one.

It seems to us extremely significant that this joint timing of the eclipse did not depend on anything new in the way of apparatus. The new thing was an idea, the idea of cooperation. By the cooperation of a great public utility company with a number of scientific organizations, an important new accomplishment of science has been made possible.

Cooperation is the keynote, too, of the radio tests with which the Scientific American was especially concerned. Four broadcasting stations—WGR, at Buffalo; WBZ, at Springfield; WGY, at Schenectady; and WOR, at Newark—cooperated most willingly and efficiently by sending out the test programs. Thousands of radio listeners cooperated just as successfully by recording them. Other broadcasters cooperated, many times to their own disadvantage, by abandoning plans of their own and by keeping off the ether so that the Scientific American's tests might not be impeded.

Other radio tests were conducted by special groups of radio engineers and by the radio amateurs, all in the completest spirit of cooperation and assistance, each to the other. Seldom, if ever, has there been an equal manifestation of mutual helpfulness toward a scientific end. We are proud to have had a part in it.

A remarkable spirit of cooperation is evidenced again by the thousands of persons, including many Boy Scouts and school students, who made observations of the precise edge of the shadow, as was suggested by Professor Brown in our January issue. The reports from these observers, as also the reports from our registered radio listeners, are pouring by thousands into the office of our Eclipse Editor. It will be weeks before these can be tabulated and analyzed. So soon as any significant conclusions are obtained they will be announced in the newspapers. We will print a summary in our next issue.

Meanwhile, our very best thanks to the tens of thousands of persons all over the country who have contributed so willingly to these cooperative projects. We hope you all got as much fun out of it as we did.

Our Point of View

The World's Debt to the Engineer

IF we were asked to name the body of men to whom more than any other civilization owes its marvelous facilities, we would name the engineers. Furthermore, if we were asked to pick from among the leading professions that one whose prominent names pass most readily, even though most unjustly, into partial or absolute oblivion, we would have to name again the profession of engineer.

During the prosecution of any great and difficult engineering construction, both the work and its author furnish good copy for the daily papers—which seem, by the way, to engage the sole literary activities of ninety percent of the people around us today. But once the great work is completed in service, the politician and the banker begin to play the star parts in connection with the enterprise, and the man of genius, who had the imagination, skill, perseverance and executive ability to put the work through, slips quietly into the background.

Fortunately, there are exceptions; though they are painfully few. To look at a locomotive is to remember Stevenson, and the river steamboat brings Fulton to mind. Charles Parsons, Bell, and Marconi, without any direct effort on their part, have stamped their names forever on the steam turbine, the telephone and wireless transmission. But for the few that, by the accident of things, have been thus fortunate there are hundreds, nay thousands, of engineers both civil and mechanical, who as contributors to the upbuilding of our modern civilization are forgotten; whose names are not now and probably never will be associated in the public mind with their public works.

William Barclay Parsons designed and built the first New York subways. To judge from the daily press and daily talk, a stranger might well believe that a certain John Hylan did it.

Our commerce thunders on steel rails across the wide span of the Mississippi, or moves safely by ship out through the bars and sandbanks at the mouth of that river; but who among us today ever thinks of the credit due to that great engineer Eads, who, by his system of jetties opened up to commerce the entrances to the Mississippi and to an untold number of harbors and rivers throughout the world.

Ask yourselves, good friends, when you have solved your nightly cross-word puzzle, who it was that built the first transcontinental railway or the great 125-mile aqueduct from the Catskill Mountains to New York City, or the vast irrigation dams of the west; or name the men who were responsible for the marvelous water turbines, generators, and vast tunnels and shafts which have made the power of Niagara available for industrial service. If you fail to answer these questions, perhaps you can call to mind the names of the men to whom we owe the present huge steel industry, upon which more than upon anything else, the industrial development of the world depends. Who was it that rendered steel so cheap that it became available for almost any constructive work of architecture or engineering? Do you realize that the world has been very ungenerous to its engineers in the matter of memorials? We have shafts, effigies and "forget-me-nots" to kings, popes, bishops, soldiers, politicians and whatnots without end; but how many great memorials can you find to the engineers who, more than all of these, have made this boasted civilization of ours what it is.

A Cathedral Should Be All of Stone

A CORRESPONDENT asks us why the great Cathedral of St. John The Divine at New York is to be built entirely of stone in an age when skeleton steel-and-stone construction is being used with such success in buildings of vast magnitude. He urges the point that in cost of materials and labor and time consumed in construction, the adoption of a steel frame with a veneer of stone, would afford the same architectural effects both within and without, and would save possibly one-half the contemplated cost.

The all-sufficient answer to this is that if St. John's were built by the methods which characterize our modern office buildings and factories, it would become at once something of a sham and would lose that element of "rocky strength and duration" which caused Dr. Johnson to pause in awe-stricken wonderment when he entered the grand old Norman Cathedral of Durham.

Built of skeleton-steel construction, the elements of romance and deep historic interest would never clothe its walls and give solemnity to its vast interior spaces. There would be a loss of that marvelous craftsmanship which we admire in the mediaeval cathedrals, many of which stand today as perfect in form and as sure in stability and strength as when their stones were laboriously piled up day by day and year after year by the mediaeval builders. It took courage and faith, and a wide range of skill and experience to erect such a gigantic structure as Beauvais Cathedral, which sustains its massive stone vault 157 feet above the floor of the church, and, by means of flying arches and vast buttresses, has maintained it in mid air for centuries.

The Cathedral of St. John is being built as a great civic-religious monument, which will stand in all its majestic perfection throughout the ages to come, and match in its perpetuity the very pyramids themselves. To build the structure of a skeleton of steel overlaid with a veneer of cast stone would rob the cathedral of that sense of endless perpetuity which will be one of its great attractions. For where steel, through hurry or inattention during construction, may find itself exposed to slow and unsuspected rusting, the carefully selected granite and limestone of the exterior and interior of St. John's will match in their indestructibility the very rock of Manhattan Island, down to which the foundations of the great church have been carried.

Any bright young graduate of one of our technical schools could draft out the strain sheets and the sections for the steel frame of a cathedral, and a combination made up of any of our great bridge-building firms, building contractors and cast-stone workers, would engage to put the structure up, complete, in two or three years; but as an expression of the age-long art of cathedral building, the result would be merely a magnificent fraud.

Would It Burst?

IN the course of a talk one day with Hudson Maxim, changing the subject with characteristic suddenness, he said, "let us accept for the moment the popular theory that our earth consists of a deep, homogeneous, solid crust many miles in thickness, and that the whole interior is filled with a molten mass of material. Now suppose you were able to empty the earth of its liquid contents and fill in the void completely with nitro-glycerine. If you were to detonate the nitro-glycerine what would happen?" Promptly we answered, "star-dust or a further supply of meteorites." "No," said Maxim, "you are wrong and I think I can prove it. Now calculate for me the weight of a column of the crust one inch square in section and as lofty as the crust of the earth is thick." "Well," we said, "such a column might weigh about 600,000 pounds." "Exactly; then I am right in telling you that, were the nitro-glycerine detonated, nothing would happen, and this for the reason that the pressure per square inch due to detonation of nitro-glycerine is about 500,000 pounds per square inch, so that there would be a margin of safety, to use that term, against the lifting of the earth's crust of about 100,000 pounds per square inch."

It has been suggested in this office that the pressures obtained by detonating, experimentally, moderate quantities of nitro-glycerine, are no sure basis in estimating the pressure effects of detonating such a huge mass as an earthful of high explosive—this for the reason that the temperatures, and hence the pressures, in the latter case might be vastly greater. Perhaps one of our correspondents, or Mr. Maxim himself, will tell us what he thinks of this suggestion.

Shaft Twelve Miles Deep

ALTHOUGH that little talk took place some seven years ago, we are reminded of it by the proposal of Sir Charles Parsons to sink a vertical shaft twelve miles in depth for the purpose of ascertaining all possible scientific facts about the terra firma upon which we stand.

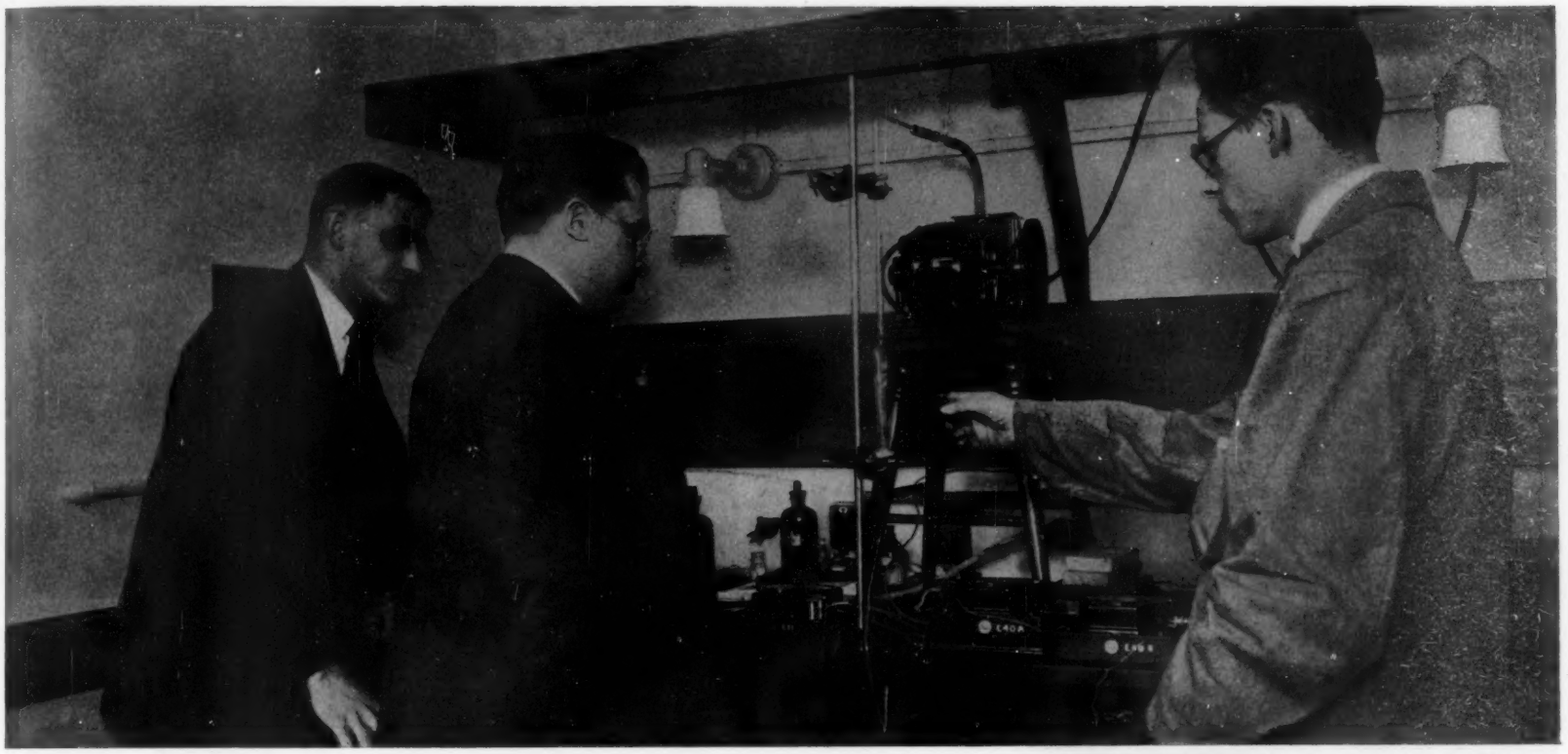
From anyone of less reputation and scientific knowledge than the inventor of the steam turbine this proposal would at once take its place among the fanciful and impossible suggestions of pseudo-scientific people, which crop up from time to time. Sir Charles, however, has not only made the suggestion but he has given a detailed account of his reasons for believing not only that such a shaft could be sunk, but that the scientific facts revealed would be worth its cost of (if we remember rightly) about 20,000,000 pounds.

If the plans of Sir Charles are followed, the shaft would be about the average diameter of a mine shaft and it would be closed at intervals of two or three miles by airtight platforms. Electric hoisting machinery placed on each platform would lift the excavated material in stages to the surface. The problem of keeping down the temperature would be met by forcing air down through the mine and cooling it by brine suitably employed at the various stages. He believes that by this method, even at a depth of twelve miles, the temperature and air conditions would be such as to enable the workmen to carry on the excavation.

When it comes to the question of the knowledge to be gained, Sir Charles seems to be less sure and a little less definite. He believes that by a study of the local geological conditions a spot could be chosen where subterranean waters could be avoided. He hints that it is not impossible that minerals of value would be met throughout the great depth to which the shaft would penetrate.

Of the extreme interest of the proposition and the popular fascination which it would exert during operations there can be no doubt; but we question whether the vast capital required could be secured even if, as Sir Charles suggests, it should be carried out as an international project.

J. B. W.



Our Artificial Gold Investigation

Photographs of Our Famous Experiments on Cracking the Atom

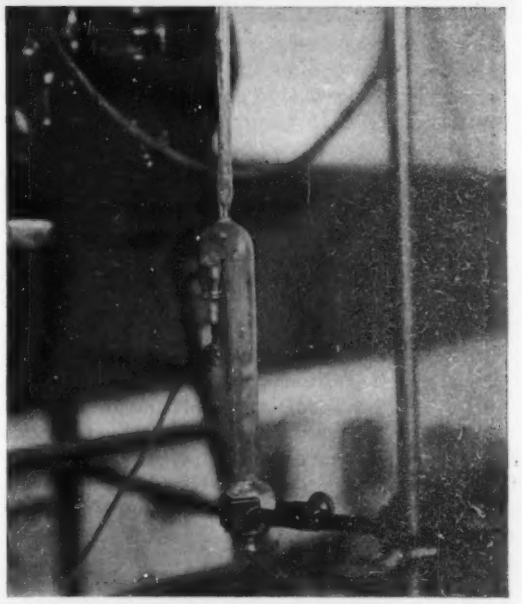
OUR attempt to repeat the German experiments of Professor Miethe and to make gold out of mercury was announced in the issue for December, 1924. Few scientific projects have attracted so much attention from the public and the press.

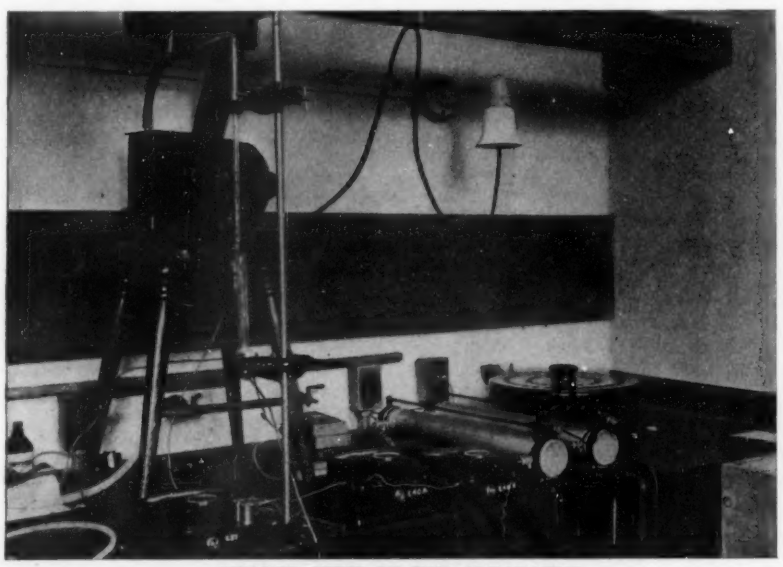
The experiments are now actively under way in the Physical Laboratories of Washington Square College of New York University, under the direction of Professor H. H. Sheldon. In the photograph above Mr. Roger Estey, who is actually operating the apparatus, is pointing to the tube in which the electric arc is produced. Professor Sheldon is on the left and Dr. E. E. Free, Editor of the Scientific American, in the center.

At the right is the special reaction tube or "lamp," made of the purest fused quartz, carefully tested to make sure that it contains not the slightest trace of accidental gold. In the bottom of this tube, and also in the well at the bottom of the bent-over arm at the top of the tube, is liquid mercury.

The tube can be connected to the vacuum pump so that all the air in it can be pumped out. Then an electric current is passed through the tube, between the two portions of mercury. This produces an arc in the tube, after which the tube is again opened to the air. Tungsten wires, sealed into the quartz, provide the contacts for the current.

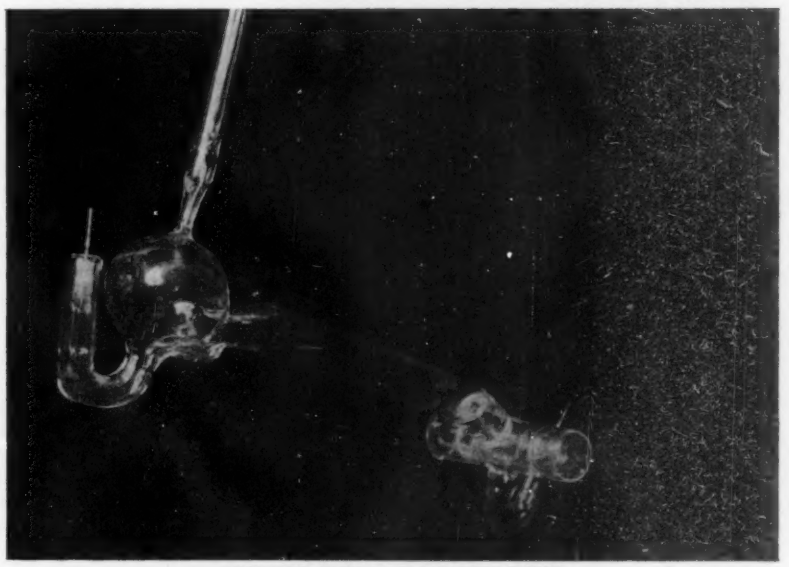
It is hoped that the passage of this electric current will knock the eightieth electron out of some of the atoms of mercury so that they will become atoms of gold.





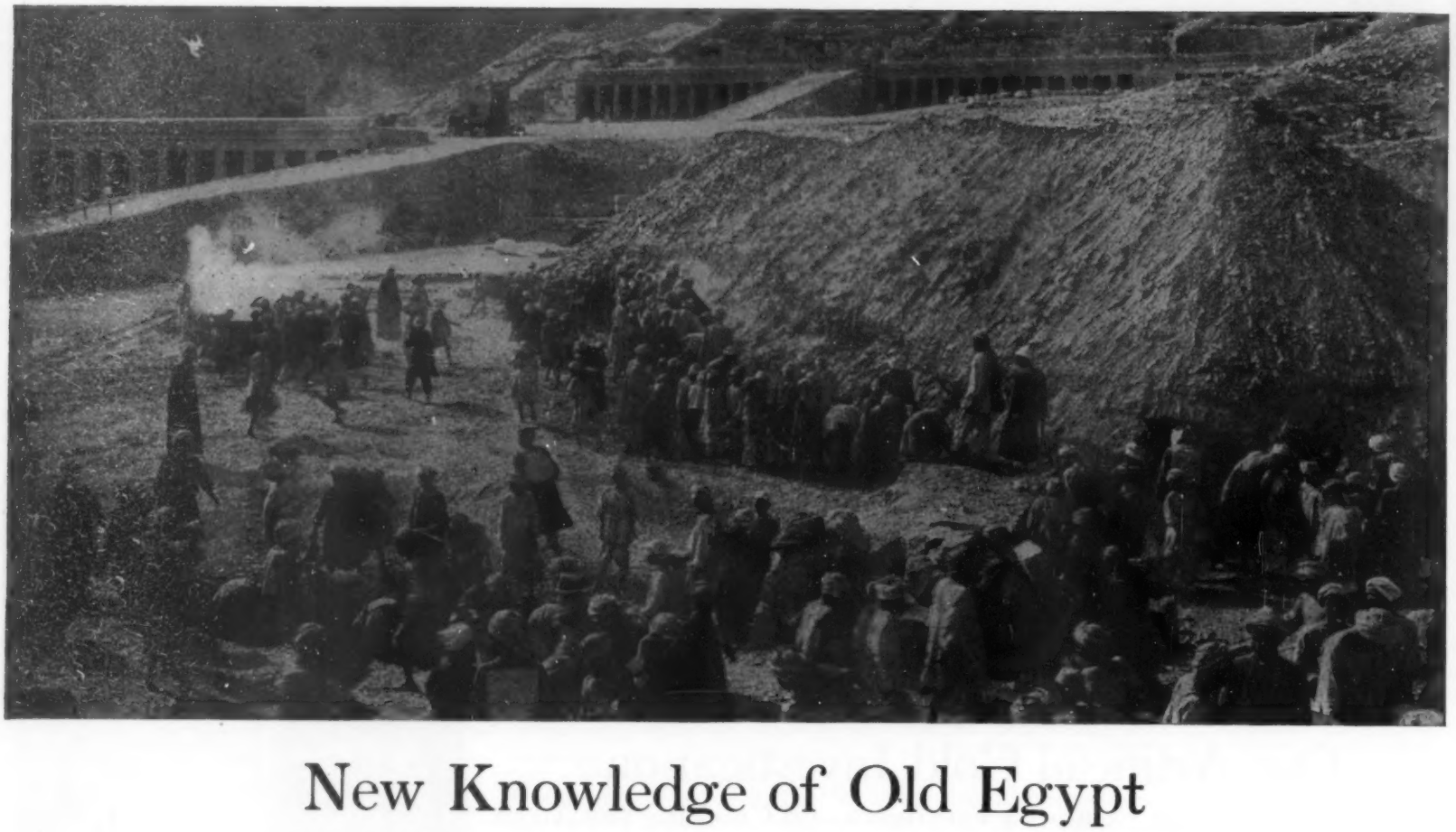
A NEARER VIEW OF THE APPARATUS

The vacuum pump is on the stool, with the mercury lamp in front of it. On the table-top are the measuring instruments for the electric current and the rheostats and other apparatus by which this current is controlled



ANOTHER TYPE OF QUARTZ LAMP

This tube, also being used in the experiments, is of practically the same design as the lamp used by Professor Miethe in Germany and in which he believes that some atoms of gold were produced by transmutation of mercury atoms



New Knowledge of Old Egypt

American Expeditions Are Adding to Our Information About Centuries of the Past

Photographs by courtesy of the Metropolitan Museum of Art

THE Egyptian Government and Mr. Howard Carter have just settled their differences amicably about the opening of the Tomb of Tutenkhamon, and there now seems a prospect of some action this season. It must not be supposed, however, that notwithstanding this delay, that explorations are at a standstill, for our own Metropolitan Museum of Art has been ably carrying on excavations at Thebes and at Lisht, and we shall endeavor to touch some of the high spots of their finds.

For the fifth consecutive season the Museum's representatives in the Theban Necropolis have been working at Deir el-Bahri, one of the most impressive spots in Egypt. Some two years ago we chronicled the find of a grove of trees in front of the XI dynasty temple of King Mentuhotep. On either side of the temple ramp was a row of large circular plots of earth which had been planted with sycamore-fig trees, and opposite the southern porch of the temple three rows of tamarisks. These efforts of landscape gardening were delineated on a sandstone plan which was mutilated to such an extent that the explorers could only guess that there was a fourth row on one side and so restored the plan. This year they found the fourth row. The ancient architect's plan is thus fully authenticated by the new discovery and the bench marks show that levels were run across the court.

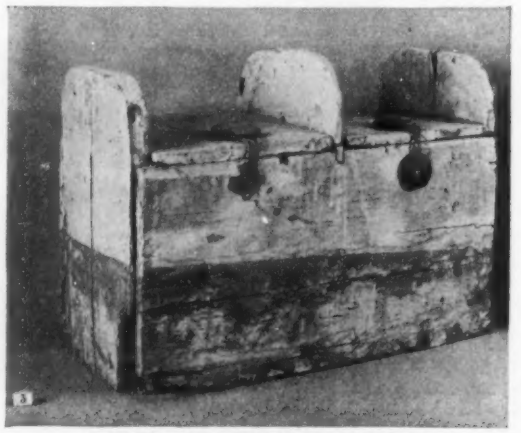
FROM A FOUNDATION DEPOSIT

The alabaster jars held the sacred oil used in anointing

Meaning of the Deposits Found

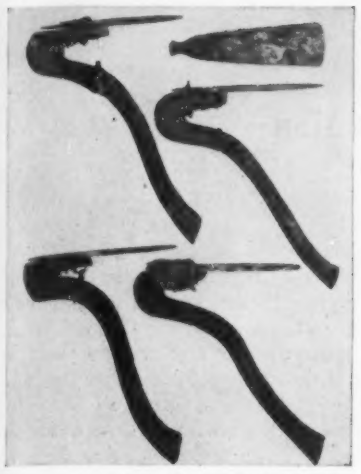
Fortune was not so kind, says Mr. Winlock, who writes the Thebes portion of the Bulletin of the Metropolitan Expedition, when the gigantic subterranean tomb called Bab el-Hosan was discovered by Mr. Carter twenty-five years ago. The enormous hole was emptied with the aid of 200 men and boys, and nothing of value was found, but an accurate survey was made. Some idea of the enormous masses of material to be handled is shown by the great mound on the north side of the Hatshepsut Court. The mound was all dug away. The great temple was almost entirely built within the earlier courtyard.

Some of the articles discovered in the foundation deposit holes were very curious and finding these articles required careful searching and sifting. Each deposit was placed under a layer of sand in a circular hole lined with brick, if it was not cut in the bedrock itself. In every one of these foundation deposits were found models of the tools with which the temple was to be built—adzes, axes, chisels, and mallets for the carpenters, and sand-sieves, brick-molds, and the curious rockers on which stones were raised, for the masons. With these tools were placed dishes of meat, bread, and fruits to represent the perpetual provision which was to be made for the gods and for Hatshepsut herself in her new shrine. In order that they might be able to consume these provisions eternally there were placed with the food magic instruments for the "opening of the mouths" of their statues as well as alabaster jars of the sacred oils with which to anoint them. On these jars, says Mr. Winlock, was found the engraved clue to the meaning of the deposits, namely: "The Daughter of the Sun-God, Hatshepsut. She made this as her monument to her father Amon at the time of stretching the cord over the Temple of Amon of Deir el-Bahri. May she be living!" Now, "the time of the stretching of the cord" was the time of the laying



A CHEST FOR SHAWABTI FIGURES

The shawabti were to serve as substitutes in the other world



MODELS OF TOOLS
Adzes from a foundation deposit

FROM THE EXCAVATION AT LISHT
Figures from the wooden models of domestic scenes

A PET GAZELLE
Mummy found at foot of a coffin

out of the temple, before the construction had been started. At this foundation ceremony a deposit was placed at each corner or other important point in the intended plan. The four new deposits defined the eastern façade of the building and from their alignment it can be seen that it was intended "at the stretching of the cord" that this front should be parallel with the oblique front wall of the Mentuhotep court, on a line different from that finally adopted. And furthermore the two central deposits are close together and in advance of the line of the others, marking clearly a place for a ramp south of the ramp actually built.

How One Pyramid Was Built

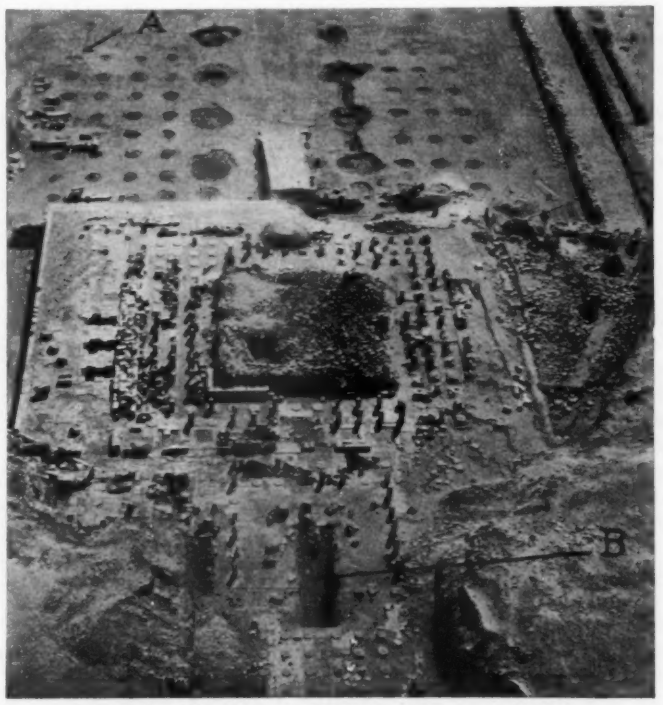
A charming idea was two shallow papyrus beds with little circular flower beds as one approached the ramp to the upper terraces. They are still filled with crackled mud just as it was when they were first allowed to dry up. In this mud one may today pick up bits of the papyrus stalks. Since some of these stalks were cut in lengths for paper making, and since among them lay a fowler's throw-stick, it would appear that as part of the dedication ceremonies at the temple, papyrus was cut and birds were caught in these miniature marshes just as Hatshepsut is seen doing on the walls of the temple in the celebration of the ritual of certain of the gods.

Various tombs and their contents are then described; we can stop only for a moment to glance at one of the Shawabti boxes. The reader may not know that these shawabtis or "respondents," were to serve as the dead person's substitutes when he was drafted for labor in the realm of Osiris. The explorers counted those in the two boxes of one tomb and found that they totaled 364—one for each day of the year with one missing. The question arises, says Mr. Winlock, was this a mistake, or was there *one* annual holiday in the future life?

At Lisht, where the excavations at the pyramid of Sesostris I. were resumed last year after an interval of five years, Mr. Ambrose Lansing describes the new discoveries which were made, and how he thinks the pyramid was constructed. The pyramid of Sesostris I. is built on a totally different system which, while it saved labor and material, rendered it much less enduring. As far as can be judged from the part now exposed—nearly half of the east face—the plan of construction was as follows: When the square which formed the base of the pyramid was laid out, eight massive walls of heavy but irregular stone were built radiating from the center of the square to the four corners and to the middle of each of the four sides. Eight more walls of equal strength were laid parallel to the latter, halfway between them and the corners of the pyramid. The ground plan thus presented sixteen chambers of irregular size and shape, their outside walls being the casing of the pyramid. A comparison might be drawn with the bulkheads and the planking of a modern vessel.

May Solve Problems of Engineering

The walls and casing described above are apparently the only real masonry used in the construction of the pyramid. As each successive course of these was laid, the spaces between were filled with smaller pieces of rough limestone laid in white sand. Adjoining the casing these smaller stones were laid with some care and a slight amount of mortar, but by no possibility could the structure stand without the protective casing blocks of the white limestone beautifully cut and laid. When quarrymen removed these at a somewhat later period, the first wind and rain storms must have dislodged enough of the then precarious structure to precipitate a slide which continued until in time the loose sand and stone found their natural slope. The curiously shaped beams show many mortises and tie holes and it is hoped that this will help us to elucidate some of the problems of Egyptian engineering.



THE TEMPLE OF MENTUHOTEP III, AT THEBES
A indicates the stumps of the long-dead tamarisk trees. B marks the mouth of a gigantic subterranean tomb

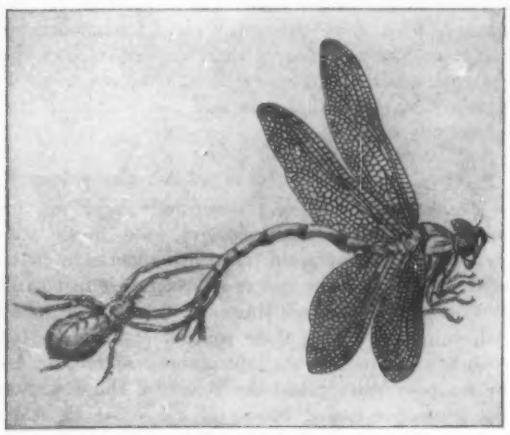
LANDSCAPE GARDENING OF 4,000 YEARS AGO
A indicates shallow pools which once held ornamental beds of papyrus plants. The holes at B were circular flower beds like those of modern gardens

The Hunting Spiders

Predaceous Habits of These Insects Make Them Useful to Man

By S. F. Aaron
Lincoln University, Pennsylvania

ALL spiders are predatory and we commonly think of that largest group of the Arachnida as snare builders, the greater number deserving to be so called. All are endowed with thread-making organs: the secreting abdominal pouch and the spinnerets. But many spiders spin their numerous strands, combining them into one, only as a means of protection to themselves and their young; as cocoons to enclose the egg sac only, or as a cabling device to aid their travel, insuring a safe descent and a possible return to a point of vantage.



MORE THAN SHE BARGAINED FOR

The crab spider sometimes tackles a more than worthy foeman, as, for example, a dragonfly which is strong enough to pull the spider from her moorings and fly away with her

The geometric web builders, having a greater need for a quantity of web than those species that do not make snares, possess comparatively large abdomens and a more plentiful supply of the liquid which turns into silken thread. And yet the supply of this material that is possessed by those forms that do not build snares seems to be endless, for almost everywhere these spiders go, strands of silk mark their progress, easily to be traced on walls and windows, along fences and over the trunks of trees.

Lying in wait is the easier and probably the surer way of getting a food supply that consists of ever-moving and watchful victims and, if we are erring enough to consider nature's methods perfect, it would be rather surprising that all spiders do not put their silk spinning powers to the making of snares. Some species that do not build snares lie in wait, as the crab spiders (Misumena), and the trap door makers (Mygale and Cteniza). Nearly or quite all of the other species are more properly called hunting spiders and these include the jumpers (Atta and Phidippus) and the true ground spiders (Lycosa).

The predaceous habits of spiders make them most useful to man. Our selfish interests should preserve and protect them, except where they annoy the housewife by building dust-catching and unsightly webs indoors. Even then they might be given a place. All forms are diligent producers of their kind and were it not for their numerous enemies there would be enough spiders to considerably alter the overproduction of noxious insects.

In comparison to the insects there are few spiders, both of species and of individuals. Considering the number of eggs spiders lay and the protective care they give their eggs this seems surprising. But when we observe the ceaseless activity of birds, shrews, toads, snakes, lizards, robberflies, certain parasitic insects and, most particularly, mud dauber and digger wasps, it is more surprising that spiders exist at all.

Spiders do not want for means of sustenance. There is enough of their particular kind of game to go around and much over and they know how to gain it. It is productive of a thrill to watch a jumping spider capture a victim; any kind of Arthropod that is not capable of making a sharp defense. The hunting spiders seem to know instinctively all those invertebrate creatures possessed with stings, poisonous mandibles, powerful jaws and a tendency to hunt trouble. Thus, the larger warlike ants, the tiger beetles, the robberflies, the assassin bugs and the predatory larvae of ladybird beetles and golden-eyed flies are very naturally shunned.

Spiders choose as their prey those lepidopterous larvae not armed with poisonous spines, many adult moths and smaller butterflies, the two-winged flies generally from the slow, droning gnats to the swiftest large-muscled species (Musca and its allies), the helpless aphids and their faster-running relatives (Psylla), the waterflies (Perla), dayflies and caddis flies and those other members of the Pseudoneuroptera known as bark flies (Psocidae).

Jumping spiders rarely exceed half an inch in length and are more often observed when much less than that; they present a striking appearance because of the large, bright, emerald-green mandibles. Their retreats are folded leaves, or two or three leaves drawn together with silk, these hiding places also housing their egg sacs and young. When they peep out of these tight little pockets and are viewed through a magnifying glass the ogre-like stare of the many eyes is truly startling.

Four Pairs of Legs An Advantage

These jumpers show the smartest habits of combined caution and daring; their attacks are remarkable for stealth and a final suddenness. Their first approach is cat-like and no feline could do it better; their final leap is so quick that if it were a little longer it would almost defy the eyes of the observer; by this means they not infrequently capture the swiftest bee-flies and Bombus flies that happen to alight near them.

The ground spiders select pretty much the same bill-of-fare as others of the Arachnida, except that they miss certain kinds of insects that seek the light and more open spaces and they add the softer-bodied and weaker-jawed ground beetles, immature crickets and grasshoppers and the smaller adults of these, walking-sticks and even the praying mantis. It in turn seeks to make victims of spiders and sometimes gets the upper hand when the latter are unsuspecting.

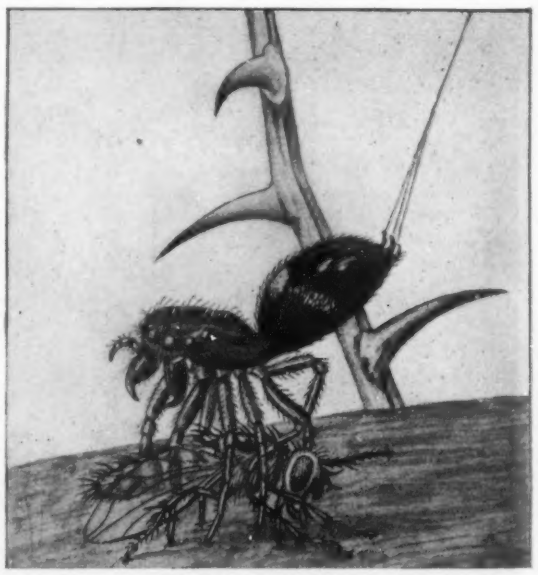
Very little is known of the hunting habits of these spiders, for they keep well within the denser jungles of grass, weeds and ground-trailing vines. They fear birds and certain digger wasps. Most often ground spiders are observed carrying their silken, egg sacks which adhere to their spinnerets.

It may seem odd that spiders have eight legs when experiment has proved that they can get along as rapidly and climb about as surely with half the number. But observation shows that they make excellent use of the four pairs in many ways. The web makers stand on six legs and use the hind pair to wrap the entangling meshes of web around their ensnared victims and also to draw the web tight across bridged spaces. The nest makers need at least eight legs with which to draw together and hold the edges of leaves and grass stems. But far more important is the ability to lose a leg or two when attacked by an enemy, rather than be held a victim. This is characteristic of some insects, particularly the locust, crickets and grasshoppers.

The many legs of spiders are also useful as a means of fencing in a victim until the jaws can get in their work. Set closely together, the tibia and tarsi inclined inward, the legs form a sort of cage to prevent escape of the victim. It is also an advantage to have two pairs of hind legs with which to cling to a surface while the two pairs of forelegs are employed in seizing the prey. The exceptionally long anterior pairs of legs of the crab spiders are thus used upon unsuspecting and harmless visitors to honeyed flowers.

Medium-sized victims are encompassed by the legs of the average hunting spider, no matter how much of a spread the legs show. The larger water runners and the prairie tarantula stand on a base of at least thirty square inches, but to bring the legs near enough to prevent the escape of their victims, and these may include a lubber grasshopper, one of the larger beetles, a big moth or butterfly, they must narrow this to a space of not more than four to nine square inches.

The efforts of the crab spider to capture its victims often require much patience. Though the little creature seems to know, probably by scent alone, what she may safely tackle and rarely makes the mistake of seizing anything that may injure her, she nevertheless errs sometimes as to the size of an intended victim and taking firm hold of a large butterfly or other strong-winged honey-seeker finds herself carried away in mid-air, an experience not altogether agreeable to any eight-legged creature, excepting perhaps the ballooning spiders.



SHE CARRIES A PRISON WITH HER

A jumping spider capturing a small Tachinid fly. After she springs upon her victim the legs are placed so as to imprison the fly. The huntress generally carries her thread with her

From a mural by Charles R. Knight. Copyright by American Museum of Natural History

Cavemen used fire for light as well as heat.
Soon we will use it for neither

The Age of Fire Is Passing

Important New Developments of Electric Heating that Promise Much for Industry

By Calvert Townley
Assistant to the President, Westinghouse Electric & Manufacturing Co.

REALLY great changes in human affairs take place inconspicuously. The substitution of bronze for flint, of iron for bronze, of the printing press for the scribe, and of mechanical power for human labor, and the introduction of electricity—each of these events occurred so gradually that probably even those directly concerned hardly realized what was going on or appreciated its immense significance.

A case in point is a cultural change now in process which promises to be as profoundly revolutionary as any that have preceded it. The facts are common knowledge, and yet their import seems to have escaped attention. This change is nothing less than the gradual abandonment of man's most ancient tool—Fire.

Fire is undoubtedly the most valuable of all man's utilities. It was probably the chief artificial factor in his transformation from beast to human, and it is certainly the basis of our present civilization. We are dependent upon it every hour, not only for our comfort but for our very existence; and if it were taken from us, we would promptly revert to a condition close to that of the gorilla.

Fire Is Crude and Terrible

But fire remains today just what it was when it was first snatched from a volcano or nourished after a lightning stroke—a crude, intractable, and terribly dangerous thing. In spite of our progressiveness in many directions, we still retain this relic of savagery in our homes and in our factories. The scientists of A. D. 5000 will very likely class us with brutal frankness among the "Primitive Users of Fire." It is high time we were finding a better source of heat. Until electrical development was well under way, there was no hope, and indeed no thought of finding a substitute for fire. Fire was a thing apart, with nothing in the world like it. But in the very earliest experiments with electrical energy it was found that this mysterious force could be completely transformed into heat, and ever since then efforts have been unceasing in applying this fact practically.

At first the prospects for great success in this direction were small, because due to the many transformations from prime mover to point of application, only an insignificant percentage of the original energy is available as electricity; but with increasing experience, it became clear that this limitation, though serious, was not fatal; and, if certain electrical developments now under way are carried through to their logical conclusions, fire will cease to play a conspicuous part in the daily lives of progressive peoples.

The first effective step towards a fireless future was, of course, the substitution of the electric lamp for some kind of a flame for illuminating purposes.

Next, came the use of the electric motor in the place of numberless small steam engines and their necessary boilers and fire boxes.

The third step was initiated by the man who first bored a hole in a flatiron and placed an electric heater therein. This simple conception opened up a wide field of development, and there was soon available a line of electric household utensils ranging from the warming pad to the stove.

The next step, and the one in which the electrical industry is at present especially interested, is the substitution of electricity for fire in producing heat for industrial purposes.

Heat Is Needed in Every Factory

Only one who has given the subject some study can realize how important heat is to industry and how numerous and varied are its applications. Almost every manufactured article requires heat at some point during its production, and provisions for warming, drying, baking, melting, bluing, tempering, steel hardening, or some other heating process are to be found in almost every factory.

Prior to the war, all of these operations, with trifling exceptions, were carried on by means of fire; and since fire-heat had been used from time immemorial, it was most difficult to convince anyone that a different method could be employed to advantage. But the war speeded up evolution in the art of heating, as it did in many other lines; and ever since the armistice, the use of electricity for heating has been increasing rapidly.

The Newest Kind of Heat

There was a time when men used fire for light as well as for heat. We have got over that now. Electricity is so much more convenient. Mostly it is cheaper.

Presently, says Mr. Townley, we will be using electricity for heat too, instead of sticking to our antiquated methods of fire-heating, methods which are really as old as the caveman.

But is not electric heating too expensive?

Not always. Even now there are many heating operations in factories which can be done *cheaper* by electricity than by fire. The reason is that electric heating is uniform and controllable. It causes less spoilage.

And presently we will be building our houses for electric heating. No more furnaces! No more coal! No more ashes to sift on a cold winter morning! Heat, with the ease and comfort of electric light!

These are some of the possibilities foreshadowed in this prophetic article.

To explain in detail why industry is adopting electric heat is impracticable because the methods of application vary with almost every installation, but the principal reasons are briefly as follows:

Most industrial heating operations are by no means simple and easy. Products can be ruined by being heated too quickly or too slowly; by being heated for too long or too short a time; by receiving improperly distributed heat; by being subject to deposits of soot or dirt; by being attacked by heated oxygen, carbon, or furnace gases; or by being cooled too rapidly or not rapidly enough.

Fire is so complex a phenomenon, physically and chemically, that it is humanly impossible to use it with one hundred percent efficiency. No one, no matter how expert, can invariably produce completely successful results by the use of fire-heat.

But it is possible to obtain one hundred percent efficiency with electric heat. Conditions necessary for the complete success of any heating operation can be determined by laboratory tests; and then, by using electric heaters of the proper type together, if necessary, with automatic thermostatic control, automatic conveying systems, automatic mechanical ventilation, and the use of various gases in the heating chambers, these conditions can be reproduced commercially and maintained indefinitely.

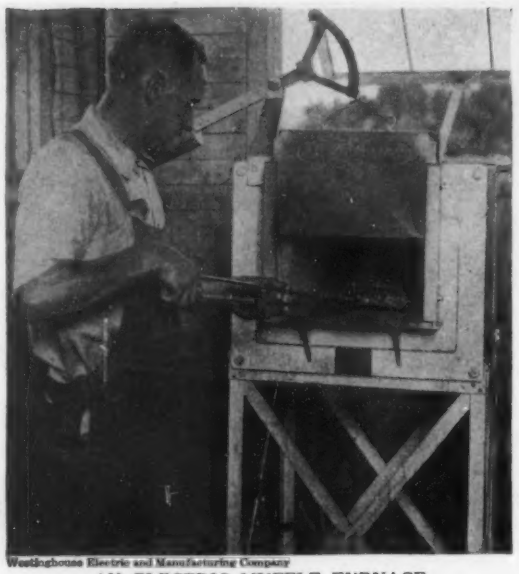
Saves Labor and Time

The practical results are that spoilage due to improper heating is minimized; a uniform quality of product, without rejects or seconds, is secured; the time required for heating is reduced to a minimum; labor is saved due to the extensive use of automatic machinery; working conditions are improved through the elimination of excessive heat and noxious gases; and the danger of fire and explosions is greatly reduced.

An excellent example of the use of electric industrial heat is the process employed by a large automobile factory for enamelling fenders, hoods, and splash guards.

The baking of an enamelled surface is a delicate heating operation. If the baking is conducted at too low a temperature or for too short a time, the resulting enamel will be full of tiny holes into which dust will enter and not only dull the finish but eventually injure the protective coating; while if the baking is too intense, the enamel will be hard and brittle and will chip off easily.

After a study of the temperature, time, heating rate, and other conditions necessary for producing the highest grade of enamel, the automobile company in question designed an equipment which operates as follows:



Westinghouse Electric and Manufacturing Company

AN ELECTRIC MUFFLE FURNACE

This type of electric furnace is much used for the precise heat treatment of small metal parts

The parts to be enamelled are first thoroughly cleaned and they are then hung on an overhead conveyor, which moves at a carefully calculated speed. First the parts are carried into a preheat oven, twenty feet long, where a temperature of 440 degrees, Fahrenheit, is maintained. Then they are carried down into a dipping tank, where they receive a coat of enamel, and, after a short run to permit the surplus enamel to drip off, they enter an oven, thirty-seven and a half feet long, where they are baked at a temperature of 440 degrees, Fahrenheit. Leaving this oven, the parts enter a second dipping tank, where they receive another coat of enamel, and after dripping again, enter a second oven, sixty feet long, where they are baked first at 350 degrees and then at 450 degrees, Fahrenheit. A short cooling run follows, and the process is completed.

This installation, which supplies the parts for 125 cars, has an electrical capacity of 500 kilowatts. Obviously, the cost of current for operating it is considerably greater than the cost of fuel for a similar fire-heated system, but nevertheless, *the cost per unit* of the electrically heated parts is less than that of fire-heated parts. There are several reasons for this: first, the electrical equipment requires but three men (two to load and one to unload the conveyor) instead of the twelve or more men needed by the use of a fire-heated system; secondly, it has reduced the number of rejected parts from as high as fifty percent to almost nothing; and thirdly, it requires practically no attention while in operation, and in four years of service, has needed no replacements beyond a few fuses.

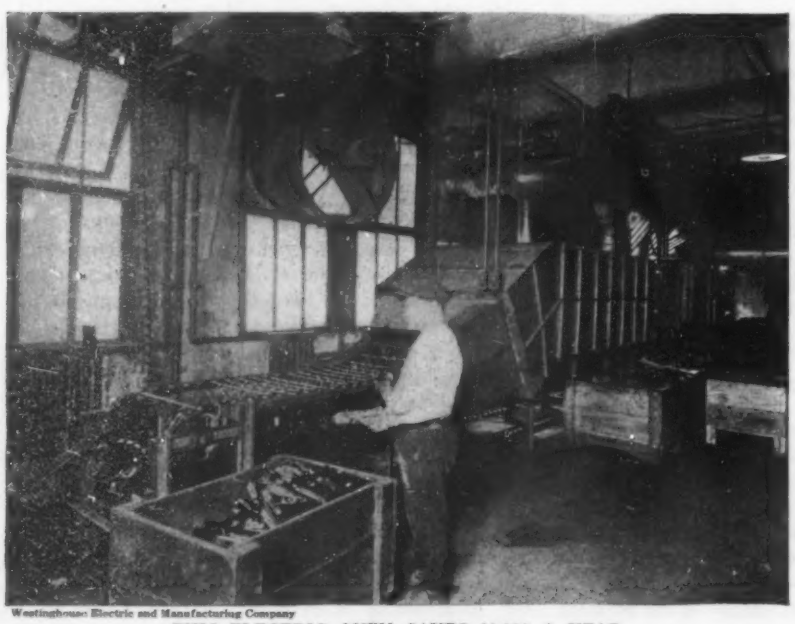
Rates at Which Electricity Pays

These economies are the chief advantage of the new process, and are typical of those secured by electric heat in other industrial applications. A secondary advantage is the improvement made possible in quality. The automobile industry has been one of the most progressive in adopting electric heat, and the splendid finishes of many modern cars are due to electric baking.

If gas costs one dollar per 1,000 cubic feet, and fuel oil costs six cents a gallon, then, for the following typical applications, the cost of electric heating equates with the cost of heating by fire when electricity can be secured at the rates given. But electric heating may still be more desirable than fire-heat at even higher rates because of other advantages.

Applications	*Electricity, Cents per Kilowatt-hour*
Bread baking, retail, small ovens	2.5
Bread baking, wholesale, large ovens	1.5
Enamelling ovens, large, conveyor type	2.0
Enamelling ovens, small, box type	2.5
Tempering furnaces, small	2.0
Glue pots	5.0
Solder pots, large	2.0
Solder pots, small, self-contained	5.0
Babbitt pots, self-contained	3.5
Space heaters	4.0
Small industrial ovens	4.0
Lead hardening baths	2.0
Galvanizing tanks	1.0
Core baking, medium sized ovens	1.0
Core baking, small ovens	2.0
Glass annealing	1.0
Armature baking	2.5

These rates seem low in comparison with those generally charged for lighting where the amount of energy purchased is small, the load-factor poor, and the cost of distribution high. But they are not lower than the rates which prevail in many instances for large power users under favorable conditions, so that there is nothing visionary about the general use of electric heat by industry.



Westinghouse Electric and Manufacturing Company

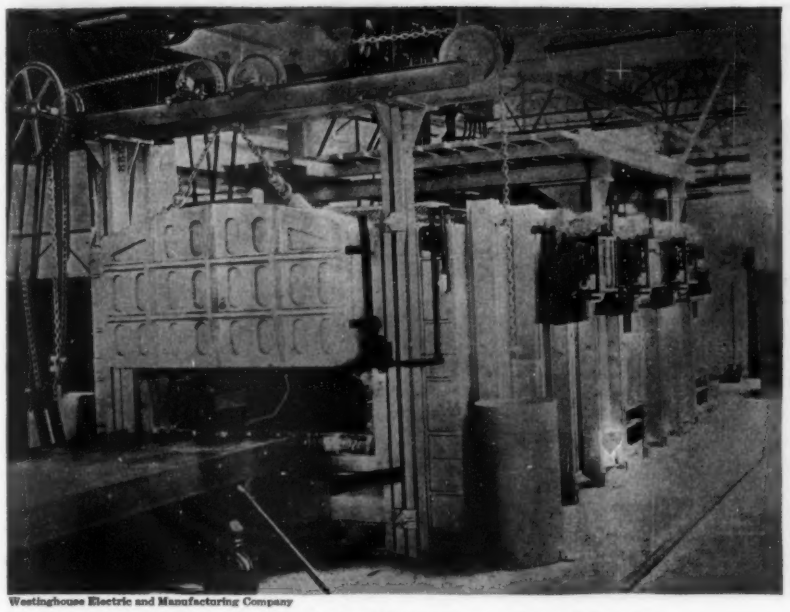
THIS ELECTRIC OVEN SAVES $8,000 A YEAR

The Metal Stamping Company of New York use this equipment to bake enamel on metal parts for automobile bumpers. Spoilage has been enough less to save the $8,000

Westinghouse Electric and Manufacturing Company

ELECTRIC HEAT HELPS MAKE SHADE-ROLLER WIRE

The steel wire used for springs in window shades needs to be tempered in baths of melted lead, hot air and oil. The Stewart Hartshorne Company uses electric heat for this



Westinghouse Electric and Manufacturing Company

THIS FURNACE LOWERS COST OF BRASS TUBES

In annealing tubing the French Manufacturing Company find the electric furnace decreases oxidation and lowers the pickling time at an increased cost of only $2.50 per day

Westinghouse Electric and Manufacturing Company

ELECTRIC HEAT HELPS MAKE STORAGE BATTERIES

The lead grids used for storage batteries have to be cast in heated molds. The electric heater shown on the low bench does this. Another electric heater keeps the lead melted

Heating methods vary for almost every industrial process, and study and experiments are needed to find the proper way to use electric heat in almost every instance. Up to date this work has been completed for only a relatively small number of applications, and consequently, the use of electric heat is still limited. But the electrical heating engineer is exceedingly active, his numbers are multiplying, and every day sees some new problem solved.

A Billion Dollars for Heat

But even without further research the commercial possibilities of industrial electric heating are very great. The total capacity of the present installations in the United States, is around 1,250,000 kilowatts. Of this total about 1,000,000 kilowatts is being supplied with current from public service power lines and provides the power companies with an income of nearly $40,000,000 a year. It is conservatively estimated that electricity is as yet being used for less than two percent of the now practicable installations, so that the power companies have in sight an annual income of over a billion dollars from this source alone, and the electrical manufacturers and contractors can look forward to a demand that is far in excess of their present facilities.

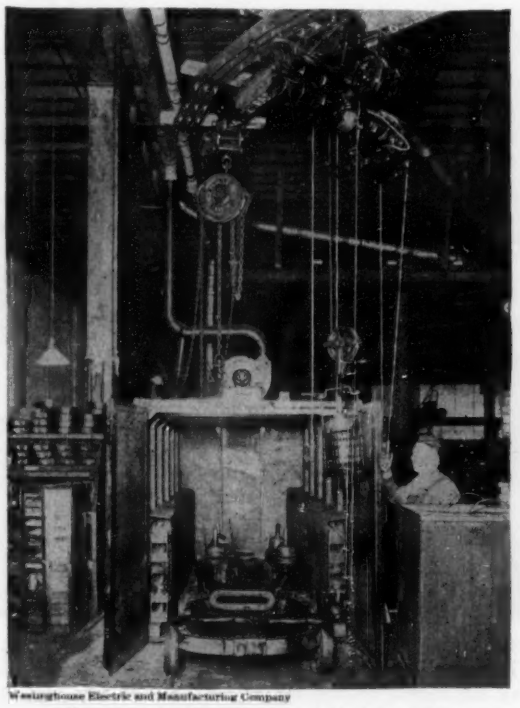
Will it ever be practicable to take another great step in the elimination of fire by using electricity for heating houses? The idea is most attractive. Consider the luxury of a heating system that is automatically regulated by thermostats, so that the temperature in each room is maintained at any desired point regardless of the degrees of cold outside; that distributes the heat evenly without cold or hot spots; and that can be readily combined with automatic ventilating and "tempering" systems to keep the air pure and the humidity at a point of comfort.

All problems of the design and construction of appliances necessary for electric house heating were long ago solved with complete success, and the method is used with entire satisfaction where surplus hydro-electric power is available.

The greatest deterrent to electric house heating is the cost of electric current. By far the greater part of the energy supplied by central stations is produced from coal, and it requires from three to over four times more coal under the boilers of a central station than it does in a furnace or in a grate to deliver a given number of heat units for house heating. Therefore, although power house coal costs less per thermal unit than domestic coal, the difference is less than the proportion above given and the saving is not sufficient to offset the cost of the larger quantity consumed. In addition to a higher fuel cost, the generating and distributing systems for electric current require a heavy investment, the fixed charges on which place an additional burden on electric heating. The result has been to narrow the field for electric house heating to that where convenience rather than cost is the controlling factor, as for example, on chilly mornings and evenings in the late spring or fall when other heat is not readily available, or to supplement fire-heat.

But notwithstanding the obstacles described, the field for electric heat has steadily and rapidly expanded and there is no reason to suppose that its limits have been approached or are even in sight.

Some years ago electric cooking was looked upon as theoretically interesting but commercially impracticable on account of its cost, but the enormous demand for electric ranges and the great variety of smaller electric cooking appliances has proved that the importance of convenience was overlooked in making this assumption. It is, therefore, not unduly optimistic to expect a similar increase in the applications of electricity to house heating.



Westinghouse Electric and Manufacturing Company

BAKING MOTORS WITH ELECTRIC HEAT

This electric furnace is used by the Long Island Railway to bake the parts of motors, thus prolonging their life

Another factor may also act in favor of electric house heating. Many electric appliances are used in the summer only. As these multiply and call for additional power station capacity, it may readily happen that a very considerable part of the fixed charge on invested capital which now would be allocated against electric house heating will be transferred and reallocated, thus affording an additional reduction in the house heating current rates.

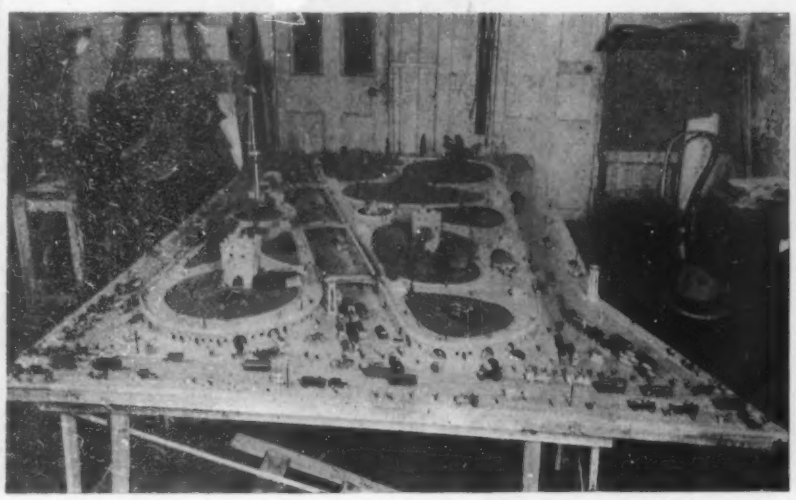
Houses Must Be Redesigned

But house heating by electricity is more than an electrical problem. Our present houses are built around fires and have been designed specifically with reference to fire's peculiar requirements. The requirements of an electric heater are, however, of a very different character, and consequently, most modern homes are about as unsuited for electric heating as a horse-drawn buggy is for propulsion by a ninety-horsepower engine. A large factor in the success of industrial electric heating is that the engineer has had perfect freedom in the design of the equipment to be heated. To utilize electricity efficiently for heating our houses we shall undoubtedly have to adopt a radically new order of architecture.

This will be a long, slow process, for in nothing are we more conservative than we are in the design and construction of our buildings. But if we want electric house heating, we shall have to rearrange our home life to meet its limitations, just as Neolithic man rearranged his and invented the house in order to secure simultaneously the comfort of a fire and protection from the weather. We shall also be compelled to develop every possible source of electrical energy and perhaps find a few that we know nothing of at present. When these things are done, the end of a long, long "Age of Fire" will be near.

Fire will, of course, never be completely banished from man's life, any more than bows and arrows, candles, or wagons ever will be. But in civilized communities, its extensive use is likely to be confined to great superpower steam plants which will be located in remote places, so that even by the Twenty-first Century, children may have to visit museums in order to see that strange thing which helped to confer humanity upon their forefathers.

Model Maker Suggests Way to Help New York Traffic



In a little shop on the Bowery in New York, Mr. Alexander Hopkins has built a model of how Union Square would look if the park were elevated and landscaped to make a promenade. Underneath would be a garage. Broadway runs through the park

A view of the model from the uptown end, giving an idea of how little space would be lost by the plan. The formal gardens and the esplanade would be a more than satisfactory substitute for the present park. Stairways would give easy access to the terraces

Mr. Hopkins modeling a little house out of cardboard. It is easy when you know how. The secret is to tie the house together with wire, so that the shape is preserved

When this little model is completed it will be a fire alarm pillar with a red lamp attached. The lamp is a red bead. The post is made of twisted wire painted red

Making a tiny figure of a man. The torso is a druggist's capsule through which a pin is pushed so that the head of the pin forms the head. The arms are of wire

Mr. Hopkins removing the roof of one of the garages, showing the interior arrangement and storing of the automobiles

The picturesque shop where the model was built shows the greatest imaginable variety of tools and of odds and ends. Anything may be useful to the model maker, an old spool, a bead necklace, bits of wire—everything comes in handy

In a tree, the trunk is made of twisted wires wound with tape. The foliage may be a bunch of steel wool painted a vivid green

Widening the Limits of the Universe

Two Spiral Nebulae Discovered to Be One Million Light-Years Away

By Professor Henry Norris Russell, Ph.D.

ONE of the most remarkable astronomical announcements, even of this age of discoveries, has recently been quietly made from the Mount Wilson Observatory—namely, the first reliable determination of the distance of a spiral nebula from the earth.

We have known for a decade that these extraordinary objects must be very remote, and that their light takes thousands of years, at the least, to reach us. Suspicions that they were even farther away were raised by several of their properties, but until now, these have not been definitely confirmed.

New Stars Appear by Dozens

For example, the spectra of the central regions of these nebulae (which alone are bright enough to be observed) are very similar to that of the sun. This might be expected if the light came from a huge cluster of stars, averaging about the solar type of spectrum. But even the longest exposures with the most powerful instruments show no trace of resolving the nebulosity into separate stars. A star like the sun would have been photographed even if its distance were fifty thousand light-years. A giant star of the same spectral class, such as Capella, would have been visible at ten times this distance.

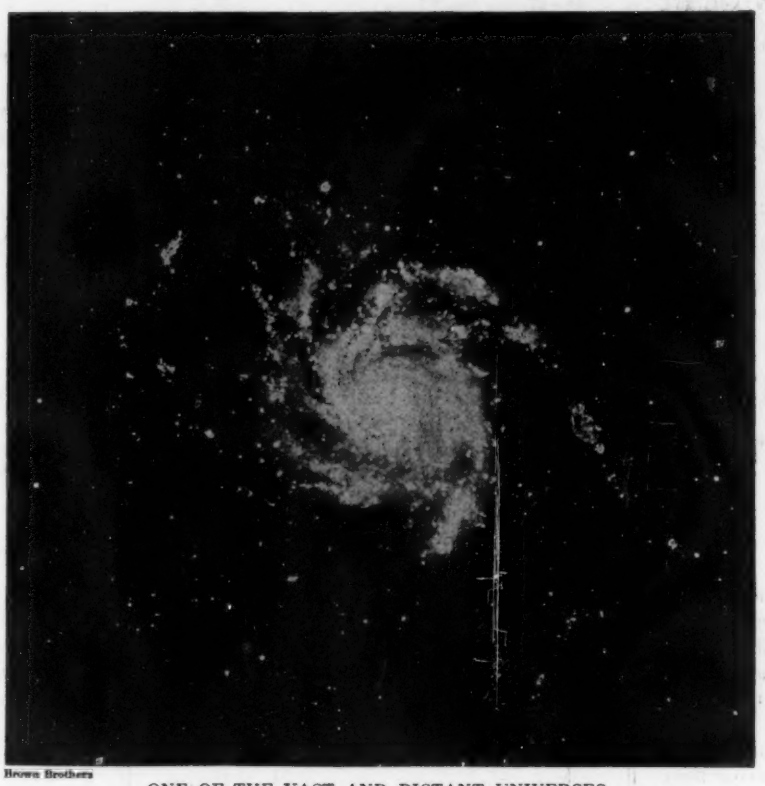
When it was discovered a few years ago that new stars were appearing, literally by the dozen, in the nebula of Andromeda, these suspicions became stronger. Those few novae which have been bright enough and near enough for us to get an idea of their distance, were, at their best, thousands of times brighter than the sun. If the tiny specks which appear in the nebula are objects of the same sort they must be several hundred thousand light-years away. But here again the evidence, although suspicious, was not convincing. We have no reason to be sure that some new stars may not really be thousands of times brighter than others. Indeed, one such object appeared close to the center of the Andromeda nebula in 1885 and was almost bright enough to be visible to the naked eye. If it was really in the nebula, it must have been more than a thousand times as bright as any of the others.

Stars That Change in Brightness

So opinions fluctuated, until Major E. H. Hubble, who has added so much to our knowledge of the nebulae in the last few years, discovered last year some faint, variable, star-like points on the edge of this same great nebula of Andromeda. Further study was laborious, for these variable specks are so faint that, even with the most powerful telescopes, long exposures are necessary. But it became plain that these objects are really stellar, that their variability is regular, and, above all, that it is of the so-called Cepheid type.

Now the Cepheid variables are incomparably the most powerful measuring instruments for great distances which science yet possesses. They vary in such a way that they can be easily and surely recognized. Their light goes up and down steadily and quite regularly, with each rise a little faster than the fall in brightness, and with a range of one magnitude or so, large enough to be easily detected. There is practically no danger of confusing them with anything else.

But what makes this class of variable stars so useful is that, in every case which has been tested, the real or absolute brightness of such a star depends only on its period of variation. If this period is less than a day the star is a hundred times as bright as the sun. The longer the period, the brighter is the star. Hence, if an astronomer can detect a Cepheid, can find out how long it takes to vary, and can determine how bright it looks, he can figure out at once how far off it is. Our readers may recall how Dr. Harlow Shapley measured by this method the distances of the globular star clusters and expanded our existing ideas of the universe ten-fold.



Brown Brothers

ONE OF THE VAST AND DISTANT UNIVERSES

This photograph shows one of the huge spiral nebulae like those which Major Hubble studied and which Dr. Russell describes in this article

Hubble's newly discovered variables in the Andromeda nebula are perfectly good Cepheids. He has worked out the periods for ten of them, some brighter than others.

The brightest ones have the longest periods. When their distances are worked out they come out substantially the same for all and at the enormous figure of one million light-years!

The way in which these stars are associated with the nebula leaves no room for doubt that they are really in its neighborhood. The only escape from the conclusion that their calculated distance is correct would appear to be in assuming that nebulous material lies between us and the stars and that their faintness is due to the absorption of light in this material, and not to great distance. But, on this hypothesis, it is altogether incredible that the absorption by the nebula (which is decidedly irregular in structure) should be the same for all the ten stars; and, if it were different, the calculated distances would disagree. Hence, this alternative seems closed, and we may conclude safely that the Andromeda nebula is a million light-years away.

This leads to conclusions which are enough to make even a case-hardened astronomer gasp. The nebula is more than two degrees in diameter in the heavens; hence, its real diameter is some 35,000 light-years—bigger than we supposed the Milky Way to be until within a few years, although only one-tenth the size that we now know it to be.

A Billion Times Brighter Than the Sun

The new stars that appear so frequently in the outer parts of the great nebula must be, in reality, thousands of times brighter than the sun, and, therefore, probably similar to the brilliant ones which sometimes blaze out in our part of the universe. It is no longer surprising that even the best photographs do not resolve the nebula into stars. Only stars a thousand times brighter than the sun, or more, would have any chance of being found on photographs, and such vast stellar bodies are rare in comparison with the great herd of fainter stars.

Whether the nebula is actually composed of stars or what else may cause its light we do not know yet, although we may now be on the way to find out. We can be sure, however, that it is by far the brightest object that has ever been measured. It is conspicuous to the unaided eye and gives at least as much light as a fourth magnitude star. To shine so, at that distance, it must be a billion times as bright as the sun. All the stars visible with the naked eye, or, indeed, with a fairly large telescope if taken together, would not give out anything like as much light.

Most amazing of all is the brightness of the famous nova of 1885, assuming, as seems very probable from its position that this new star was really in the nebula. Its calculated luminosity comes out 400 million times that of the sun. How any single body could be so prodigiously bright is rather hard to see. During the six months of its visibility this star must have got rid of as much energy as the sun radiates in millions of years. Only a direct head-on collision between two stars seems adequate to supply the necessary energy, but such a collision may well have happened in the dense nucleus of the great nebula.

Some May Be Still More Distant

As for the other spiral nebulae, one other, smaller and fainter than the one on Andromeda, also contains Cepheids, and is at about the same distance from the earth. We may hope to find the distances of a number more within a few years. Not until then shall we know whether, like the globular cluster, they are pretty much alike in size or whether like the stars they differ enormously among themselves. The Andromeda nebula, at a distance of 200 million light-years, would still be visible on good photographs.

Whether among the thousands of faint nebulae which such photographs reveal, any are so far away, only the future can tell us.

Wide World

Future Leviathans of the Skies

The Last of Three Articles on Dirigible Airships

By Alexander Klemin

Associate Professor of Aeronautics, New York University

THE problem of dirigible maintenance is one that has an important bearing on its practicability. The difficulty in maintenance is not with the metal structure of the dirigible or with the power plant. The duralumin structure, though indeed it consists of very light members, is quite as durable as that of an airplane, certainly more enduring than an airplane built largely of wood. And new dirigible engines such as those built by the Wright, Packard or Maybach companies show quite remarkable endurance. The trouble is with the fabrics of the outer covering and inner gas bags.

Undoubtedly this problem must be solved for successful commercial operation. Perhaps the metal-clad airship is the solution.

Build Them of Metal Sheets

The idea of a metal-clad airship is perhaps as old as the very art of the dirigible balloon itself. But it is only quite recently that the problem has been given serious study by Ralph Upson, a well-known engineer of Detroit, who is investigating the problem in thoroughgoing engineering fashion.

It would seem at first that the suggestion is preposterous. The substitution of heavy metal for light fabric in the immense areas of the outer covering and the inner gas bags would seem to leave no lift available for pay cargo. But Upson's ideas are more radical. He would change the design of the airship so that the sheet metal of the envelope becomes part of the structure itself, instead of being a mere cover. The single envelope might then be made to perform the functions now distributed among the following parts: outer envelope, inner gas cells, shear wires, gas pressure wires, netting and many of the rigid structural elements. In this manner a large amount of weight could be saved, and particularly in very large ships, a thin metal cover might become quite practicable as far as weight is concerned.

What Is Coming

Airships will be larger, perhaps twice or three times the size of the Shenandoah and the Los Angeles.

They will be built of thin metal sheets, thus doing away with the loss of precious gas by diffusion.

Their engines will burn heavy oil instead of gasoline, and this, plus the availability of more helium, will prevent fire.

Mooring masts, airship bases, repair shops, gas supplies for refilling and similar facilities will be almost as common all over the world as garages are now.

If man would travel rapidly he must take to the air.

There are obvious difficulties in producing with perfect uniformity, enormous and extremely thin sheets, although the problem has already been solved to a large extent. The joints in such thin sheets would be difficult to make so as to avoid gas leakage. There are numberless other design-points involved. But they are all detail questions and painstaking effort may solve them.

And certainly the exponents of the metal-clad airship make out a remarkable case for its advantages.

Stops Loss of Precious Gas

In the first place diffusion, that insidious enemy of the airship, would be cut down. Experiments show that the metal envelope is much tighter than any fabric. The diffusion is about one-hundredth of that of the best rubberized fabric, and one-tenth that of goldbeater's skin. Owing to the higher conductivity of the metal the temperature difference between the gas and the external air would always be slight. Hence the loss of gas due to such effects as heating by the sun's rays would be greatly diminished. To meet the danger from static electricity, the airship must have all its parts bonded or connected. Surely there could be no better method of bonding the airship than to have its envelope one continuous whole.

We have seen that danger of fire is not solely due to hydrogen, that even if helium is employed, burning gasoline can destroy the fabric and cause slower

but none the less sure destruction. Hence metal covering would be a distinct advantage since it would be non-inflammable. Also we have seen that hydrogen becomes inflammable only when diluted with air. If contained within a gas-tight envelope and so maintained in its original purity, it becomes a non-inflammable gas.

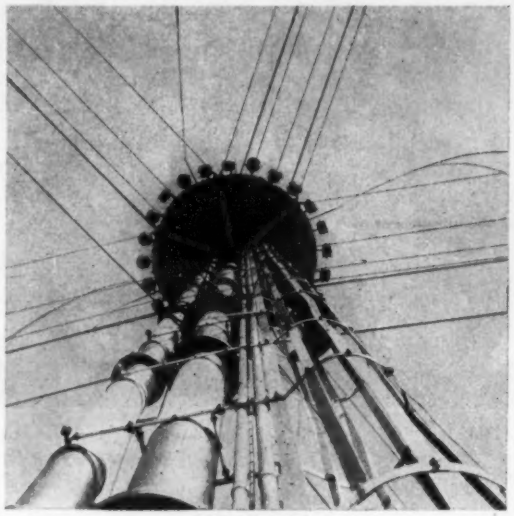
These are powerful and logical arguments in favor of the metal-clad airship, and if this type of ship can indeed be brought to a practical point, it would mean a great step forward in the practicability of airships.

Dirigibles are expensive to build, expensive to maintain and expensive to operate. But, as far as resistance to propulsion is concerned, they are extraordinarily efficient. Given a steamship and an airship of equal gross weight and equal speed, the latter will require only about one-tenth the horsepower of the former. Herein lies the very justification for the airship's existence. The difference in power is not saved, however, but utilized to gain speed. A speed of eighty miles per hour is impossible for a steamship. To drive it at that speed the entire hull would have to be filled with machinery with no room left for passengers or freight. For airships eighty miles per hour is a readily obtainable speed, which will be easily exceeded in the future. And it is also a remarkable fact that on a steamer such as the Leviathan, a dead weight of 26,000 pounds per passenger must be carried while for a large airship this weight need not exceed 1,000 pounds.

Economy Lies in Larger Ships

A trip of the Shenandoah gave a remarkable demonstration of airship fuel economy. In the last leg of its trip to the St. Louis air races last October, it flew the 725 miles from Chicago to Lakehurst at a fuel consumption of about five-sixths of a gallon of gasoline per mile. An average speed of sixty miles per hour was maintained and the ship could have easily carried five to ten tons of cargo or passengers in addition to the forty-two men of the crew. Yet the total fuel bill amounted to only $150, an insignificant amount when compared with the coaling costs of an express train on a like journey.

Comparing the Aquitania with an airship of 150 tons displacement Major Scott, the pilot of the R-34, makes an interesting comparison. The Aquitania has to use 60,000 horsepower to transport 3,200 passengers at twenty-three knots. The airship would use 3,600 horsepower to carry 200 passengers at 70 knots. The fuel consumption would be 1.2 pounds per passenger mile for the steamship, and only 0.9 pound for the airship. The steamship would have 3.23 passengers per unit crew, the airship 5.7.



A GIANT'S MOORING

Masts such as these, Professor Klemin predicts, will be a commonplace sight in the future

Nor has the limit of propulsive economy been reached. There is still much room for progress; for example, in the way of better aerodynamic shapes, which the non-rigid with its more flexible structure has already attained. But the greatest possibility of economy lies in an increase in size.

If the dimensions of a dirigible are doubled, its surface area and projected area on the line of flight are quadrupled. For the same speed its horsepower is likewise quadrupled. But the volume and, therefore, its lift vary as the cube of the linear dimensions and hence are multiplied by eight. At the same speed the weight of the power plant and the fuel consumption, therefore, bear a much smaller proportion to the whole. This means first of all tremendously increased propulsive economy. Secondly that a much greater percentage of the gross weight is available for pay load. Increase in size will only be limited, therefore, by the difficulty of handling larger vessels than the ones we have now.

The reason the Navy has been able to take up the operation of airships in spite of limited experience in their handling is because of the similarity between the handling of surface vessels and of ships in the air, particularly in docking and undocking.

But in commercial operation it is not always certain that either Navy or Merchane Marine men will always be available. Yet no problem of the dirigible is so important as that of thoroughly reliable and experienced personnel.

And there is need for efficient commanders. In the early days when airships were small, the pilot himself worked the controls. But as the size of airships increased he turned his whole attention to navigation and general command of the ship, junior officers handling the controls. The captain of the airship of the future, although he will have an intimate knowledge of the detail working of every part, will merely control and direct, his chief study being the weather, and the best method of circumventing adverse winds. He will have a skill, a responsibility and a position equal to that of the captain of the biggest ocean liner. Airship officers likewise will have to have a thorough knowledge of meteorology, aerodynamics, electricity, navigation, dynamics, engines, gases, fuels and almost every branch of physical science and engineering known to man.

Undoubtedly a good many technical problems remain to be solved before the dirigible becomes so safe and so practical as to become commonplace. Without venturing into the realm of prophecy too much, let us imagine what developments are likely to occur in this field in the next few years.

Five Million Cubic Feet in Size

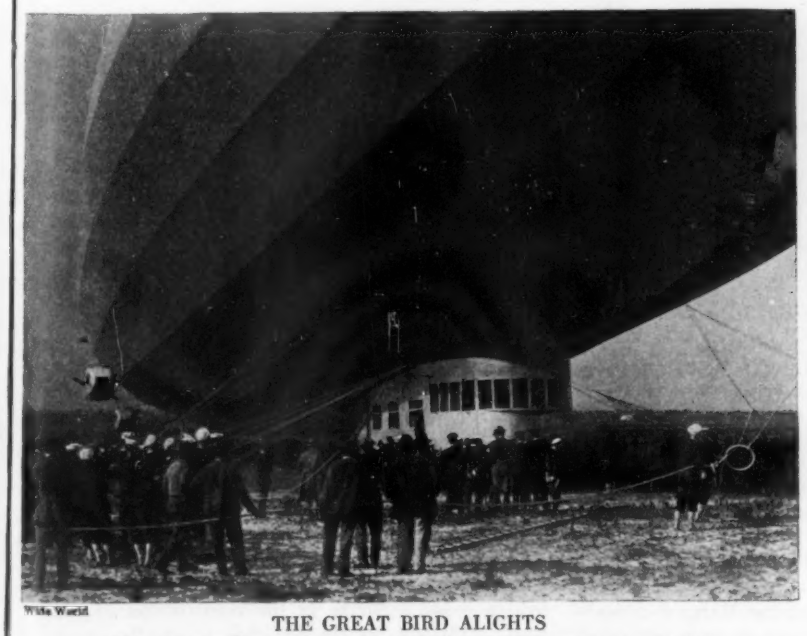
First, engines burning kerosene or heavy oils are sure to displace the gasoline engine. So many minds are working on this problem simultaneously, so much effort is being put forth that a solution is sure to be forthcoming.

Helium will be sought for in every corner of the United States and processes of reduction simplified until its cost is reduced to reasonable limits.

With the combined use of helium and high flash-point fuel burning engines the fire hazard will be eliminated to all intents and purposes.

The airship will grow tremendously in size, reaching 5,000,000 cubic feet if not more. The enormous saving in power plant weight and fuel consumption for a given gross load will be used in getting greater speed, in obtaining longer ranges, in making the structure stronger even than it is now.

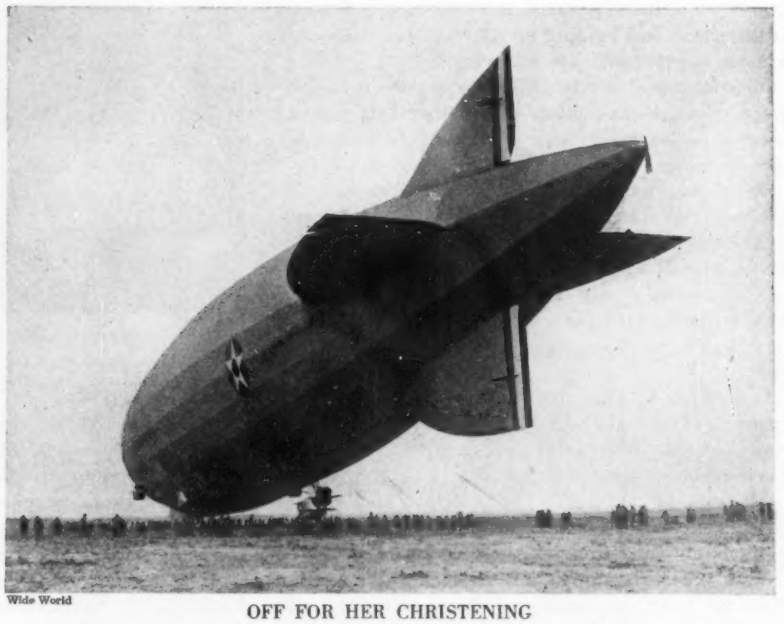
The engineers will constantly refine their methods



Wide World

THE GREAT BIRD ALIGHTS

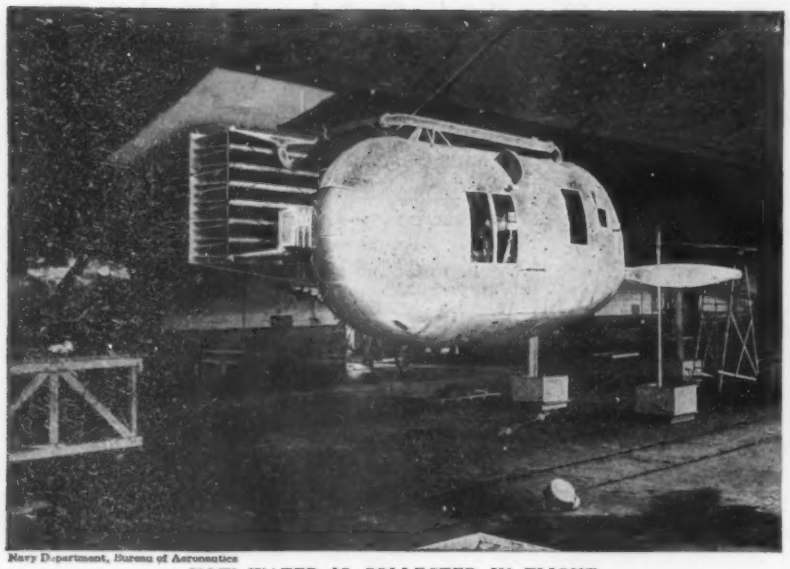
This photograph and that at the right show the many men now needed to handle the ship when landing or starting



Wide World

OFF FOR HER CHRISTENING

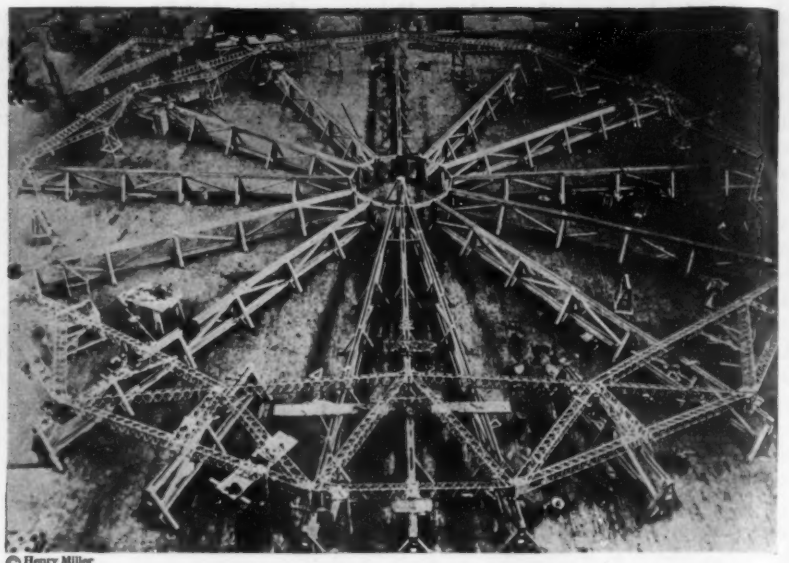
The Los Angeles leaving Lakehurst on her recent jaunt to Washington, her first trip when filled with helium



Navy Department, Bureau of Aeronautics

HOW WATER IS COLLECTED IN FLIGHT

Exhaust gases from the motors are passed through the condensing tubes shown above and behind the cabin, where the water is saved



© Henry Miller

LIKE A HUGE METAL PINWHEEL

A girder assembly for the Shenandoah showing the diameter by the huge dirigible, and how it is supported internally

of analysis until they will be as sure of their calculations as they are now in a simple roof truss, and will then build both stronger and lighter ships.

They will also learn to build their compression girders in such fashion as to utilize the full strength of the metal, not as at present having their girders fail in compression when they develop 20,000 pounds per square inch instead of the 55,000 possible in a test specimen of the wonderful duralumin.

The engineers will also find a method of building hulls which shall approximate to the ideal streamline shape already possible in non-rigids instead of the cylindrical shapes now resorted to.

Supreme for Ocean Travel

As a result of these various improvements, airships will become faster, lighter, stronger, with more pay load available for commercial work.

With the saving in weight due to increase in size and improvement in structure, engines will be allowed to weigh more per horsepower and will become as rugged and reliable as the large steam engines on an ocean liner.

As a result the whole dirigible will become more reliable, and with its increased speed and size will fear wind and weather even less.

The problem of handling will be studied intensively and the mooring mast and mooring methods so improved that landing or starting an airship will become a matter of ease and simplicity.

Meteorological service will be extended to an unheard of degree and pilots will receive full weather reports in whatever part of the world they may happen to be.

Bases and mooring masts will be found at all points of the globe. An airship will be as much at home in any quarter of the globe as it is now in the vicinity of Lakehurst.

While airships will never be built with the production methods of the Ford car, they will be built very much more quickly and very much more cheaply.

Goldbeater's skins and rubber fabric will disappear and be replaced by a metal covering or other more durable material, rendering maintenance a much easier proposition.

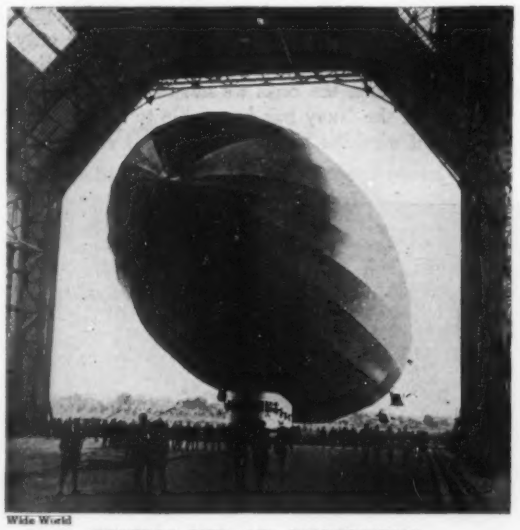
Methods of navigation by wireless and special instruments will become as sure and accurate as the methods of navigation for surface craft.

With numberless other improvements in construction, the technical problems of the dirigible will undoubtedly be entirely solved. Solution of many of our difficulties is even now in sight.

We are not prepared in this short article to enter into a discussion of the financial side of airship operation. The question is an extremely complex one and requires for its answer the closest analysis of the rather meager service experience available to date. But the consensus of opinion is that granted the solution of technical difficulties—and there will be a solution—financial success will follow, provided the real sphere of action of the dirigible is found.

It is in transoceanic travel that the airship will reign supreme. Here the airplane with its lesser fuel capacity and smaller range will be unable to compete. And as compared with the fastest steamship the dirigible shows up wonderfully well.

These possibilities for transoceanic travel are fully realized the world over, although actual construction of new ships is only being carried on in or for the United States.



Wide World

TESTING HER AIR WORTHINESS

The Los Angeles, then the ZR-3, leaving her hangar at Friederichshafen, Germany, for a trial flight

The British in particular see in the airship a wonderful instrument for linking up the Empire across seas and oceans. Brig. Gen. F. H. Williamson, Director of Postal Services for the United Kingdom, foresees the airship carrying mails on all the main imperial routes. Major G. H. Scott, of R-34 fame, projects a line from London to Perth in Western Australia, via Egypt, India and the Malay Peninsula to reach its destination in eleven days as compared with the steamship's twenty-eight days. Commander Burney is working hard on a plan whereby six huge ships would be put into early operation between London and Bombay with strong support from the British Government. Ralph H. Upson estimates that 200 passengers could be carried from London to New York in two and a half days as compared with the five and a half days for the Leviathan, with a fare of $600.

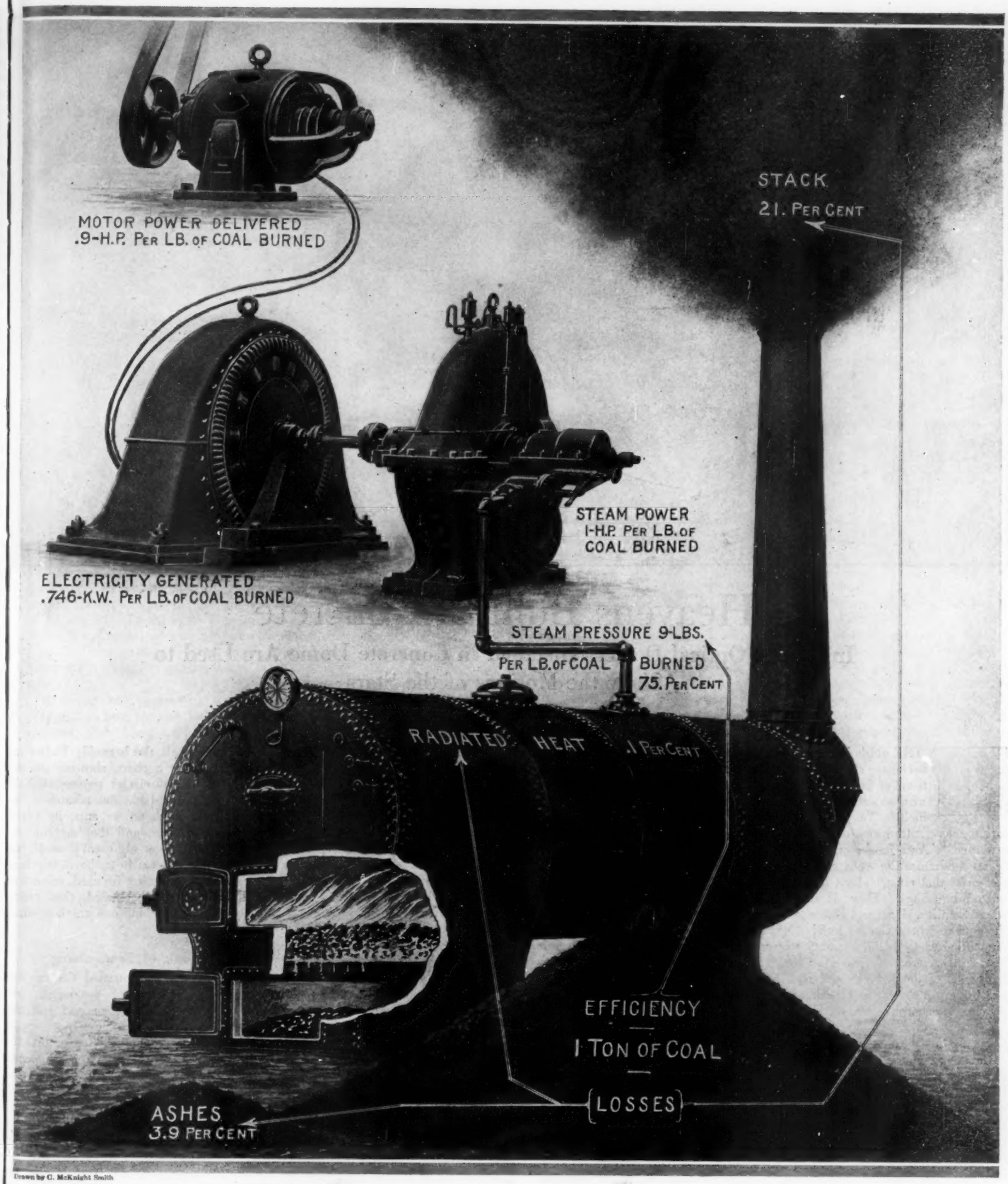
The Goodyear Tire and Rubber Company have joined hands with the Zeppelin Company, and American energy and capital coupled to German experience may achieve wonders. France has an eye to linking up her African Empire with the heart of France. With German help, there is also being planned a line from Seville to Buenos Ayres, and from Lisbon to Rio de Janeiro. Admiral Moffett sees with the coming of the airship a new era of transportation. Captain Anton Heinen points out that the present twenty-two day trip by ocean liner from San Francisco to Wellington, New Zealand, could be cut to five days, and is convinced that on suitable airship routes, with proper finances on a very large scale, safety, reliability and financial success would be assured.

Coming Sooner Than We Expect

These men are enthusiasts and perhaps biased, but one of the most encouraging points in the dirigible situation is the increasing interest which is being paid to its possibilities in the most conservative financial circles. In a recent Wall Street corporation formed to purchase the German Schütte-Lanz patents and establish transatlantic operation some of the most prominent bankers and financiers in the country are interested.

Nor will psychologic factors long hinder the arrival of the airship. We have given a fair idea of its safety and dangers. Even now it seems to leave with all those who have made any extensive trips a feeling of perfect security, a pleasant memory of calm, roominess and comfort. Disasters oft repeated have somewhat undermined the confidence of the public, but further progress and final technical refinement will bring perfect safety and complete confidence.

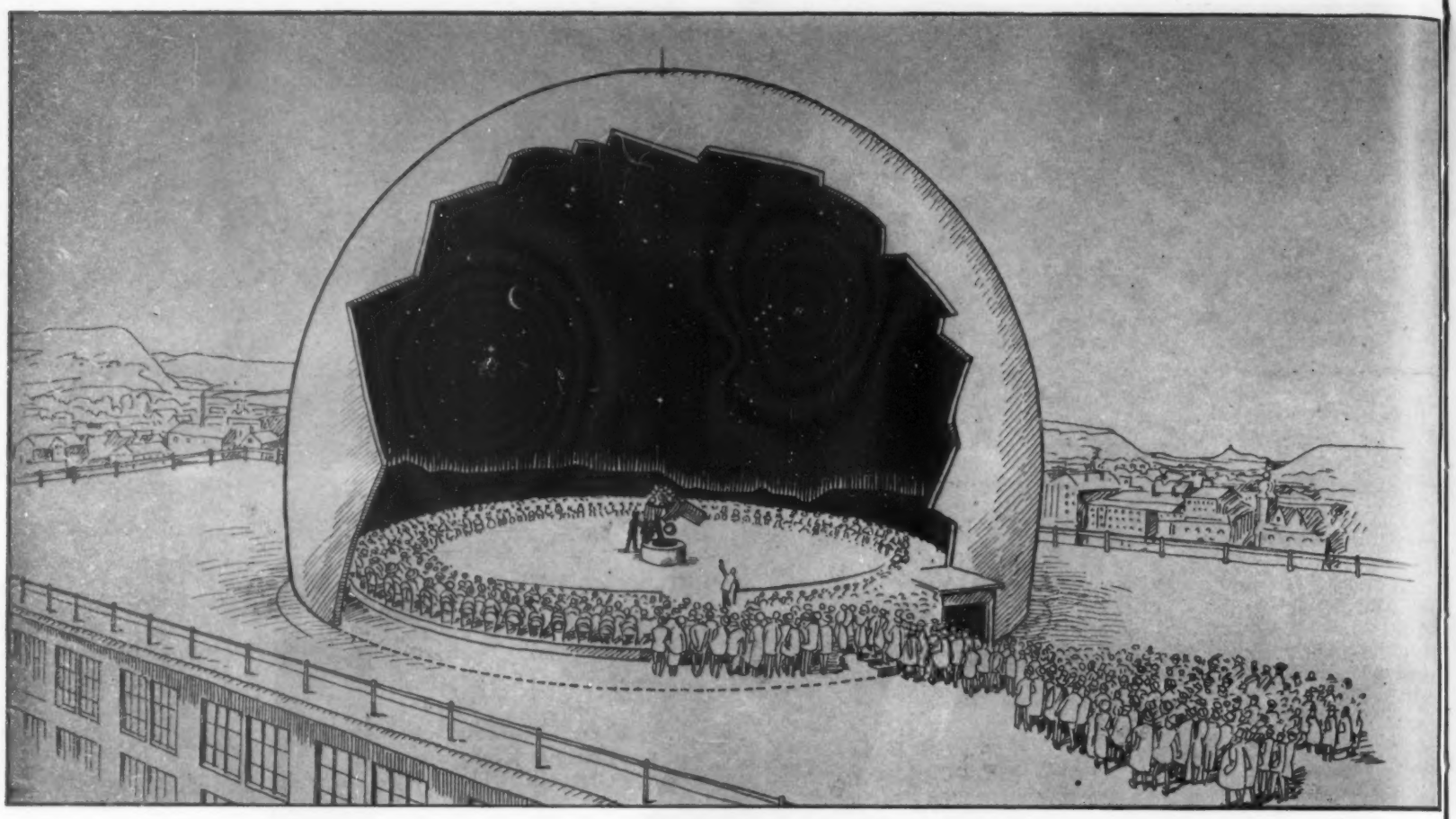
No new means of transportation of real merit has been permanently abandoned because of disaster in the early stage of development. The loss of the Titanic did not stop the building of gigantic fast ocean liners, nor did the collapse of the Quebec bridge cause a boom in the construction of ferry boats. The day of the dirigible is rapidly coming, and may be here sooner than we expect.



Drawn by C. McKnight Smith

WHAT BECOMES OF THE ENERGY CONTAINED IN A TON OF COAL

When coal is burned to produce useful power only a part of the total energy contained, theoretically, in the coal is ever delivered to the place where the power is to be used. The efficiencies of the best average practice at the present time are shown in this drawing. It is assumed that the coal is burned to make steam in an ordinary type of boiler, that the energy of this steam is converted into mechanical energy in a turbine engine, that the turbine drives an electric dynamo, and that the power produced is finally delivered for use by an electric motor. While some installations have attained efficiencies greater than those set down on the drawing, the average recoveries of power from coal are even less than here assumed. The largest single loss which is avoidable, even in theory, is the loss of heat up the smokestack. Modern engineering is gradually reducing this loss.



Heavens Built of Concrete

Ingenious Optical Devices Installed in Concrete Dome Are Used to Show the Motions of the Stars

By G. H. Morison

IN THE guide book sold in the quaint old curiosity shops of the drowsy little town of Jena in Thuringia, one learns with amazement that its chief wonders include "a girls' high school, crematorium, electric tramway, domestic water supply, and sewerage." And Jena seems to value these proofs of its modernization even more than the historical memories that cluster about its old streets and antiquated buildings. There is its ancient university where Schiller, Hegel and Fichte taught, and near-by, the cottage where Goethe lived. Not far distant is the garden where Schiller and Goethe spent so many hours in each other's society. Nestling snugly on the banks of the River Saale, Jena looks up at the precipitous hills, from a peak of which Napoleon watched the battle going on about the town below.

Sky Built on the Roof

But to none of these historic wonders is due the fact that Jena today vibrates with unwonted life. Its tortuous streets and sleepy old market place are enlivened by the shouts of crowds of gaily-capped schoolboys, and young men and women students from the universities of other cities, drawn to Jena by an attraction that dates only from yesterday. It is to be found on the roof of the Carl Zeiss optical works. From early morning till late at night a constant stream of eager visitors, mostly students from distant parts of Germany, jostle one another for places in the elevator going up to the roof of the factory where the Planetarium has been erected.

It was in 1906, when the new German Science Museum in Munich was being projected, that the director, Dr. Oscar von Miller, hit on the idea of using the great dome placed by the architect in the center of the building, for what he called a "Planetarium." His idea was that the ceiling of this dome should be a rotatable shell, representing the heavens, and that tiny electric lights should be fixed onto it to show the positions of the fixed stars. By some other undiscovered mechanism, he thought that the movements of the planets across the heavens might also be shown. The whole cupola would be made to rotate, so that those standing under the dome would obtain a fair representation of the appearance of the heavens on a clear night, and of the way the whole appears to move as the earth turns on its axis.

The work of making this Planetarium was entrusted to the Zeiss Institute, but reflection showed that in its original form, the idea was too crude. Though the dome was thirty-five feet in diameter it was by no means large enough to admit of the placing of such a vast number of tiny lights in such a way that a true picture of all the multitudes of stars visible to the naked eye would be given. And how were the moving planets to be depicted without using enormously complicated mechanism? For, as regards the planets, what was wanted was not a model showing their perfectly simple motions in closed circles round the sun. What Dr. von Miller asked the Zeiss Works to make was a model of the heavens showing the apparently complicated motions of the sun, moon and planets as they appear when viewed by an observer on the earth.

The true motions of all the heavenly bodies can be easily explained with a chart, showing the sun as the center—a series of circles representing the paths of the planets around it. But because of the daily rotation of the earth on its axis, its yearly revolutions around the sun, and the fact that the planets are also moving at different speeds, the planets appear from the earth to have the most erratic courses, sometimes going forward, sometimes standing still, again going backward, then racing forward, sometimes approaching one another, sometimes flying apart.

The Mad Monk of Frauenburg

This was the mystery that puzzled the ancients and took countless centuries of pondering over before the key to the riddle was guessed and true science at last began to unfold. For nothing, of course, could have been more natural than that the ancients should assume the earth to be the center of the whole planetary system, as the Ptolemaists assumed and taught. Nothing must have seemed more presumptous and absurd than to teach, as did Copernicus, the monk of Frauenburg, that the earth was a tiny speck that moved, while, in reality the rising and setting sun always stood still.

It is difficult to realize today how cataclysmic this change of perspective must have been. But the persecution of Copernicus and of his greater successor, Galileo, and the controversy that raged for centuries afterwards proved how difficult it was to convey even to thinking men of those days, the idea that the motions of the planets is a simple one, and not an

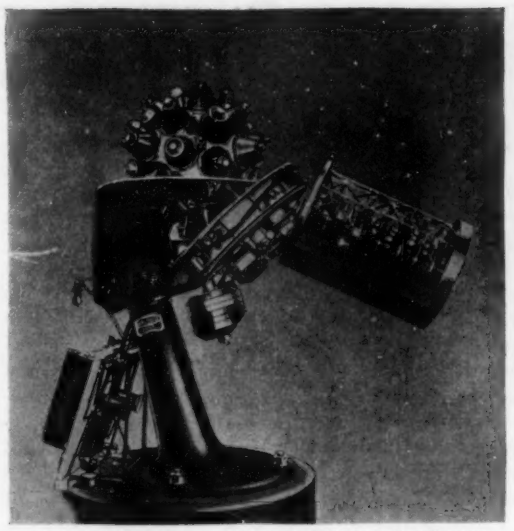
abstrusely complicated one as it seemed. But, had Galileo possessed the Planetarium now set up at Jena, his task of demonstrating the true motions of the planets would have been simple.

The outbreak of the war interrupted the work that Zeiss had taken in hand some years earlier, but in 1919 it was resumed with new zeal. It was decided not to solve the problem, as originally suggested, by mechanical means, but by optical means. The plan was to make a projection apparatus which could be placed in the center of the cupola in the Museum at Munich, and which would project onto the ceiling a picture of the fixed stars, showing their exact relative positions and brightness. By revolving this projection apparatus, instead of rotating the dome, the whole heavens would then appear to move precisely as they seem to us to move on a clear night. Then, by a special series of ingenious devices, it was decided that the seven planets would be provided for, and their extremely complicated apparent paths among the fixed stars would be accurately traced.

Even the Milky Way

The difficulty of the work as regards the fixed stars lay in the fact that there are visible to the eye no less than 4,500 of them between the first and sixth magnitudes. Besides this, there is the Milky Way, consisting of myriads of bodies only visible as a starry mist. The Planetarium as now set up shows all of these, of the exact relative brightness as seen by the eye, the Milky Way being also represented with startling realism and looking as if made of luminous star dust. The accurate picture of the stars was obtained by photographing the heavens in sections and using the diapositives to project these photographs optically onto the ceiling of the cupola. To show the indistinct image of the Milky Way, eleven special projectors are used, the whole collection of projection lenses being illuminated by a centrally placed lamp of 200 candle-power.

When it came to showing the movements of the planets, however, the task was immensely more complicated, since, besides the rising and setting of the sun, the waxing and waning of the moon, and the wanderings of the planets, the designers of the Planetarium determined to include all those subsidiary motions of the earth and the planets that bring about summer and winter, the periodic change of climate over the earth, and the variation of appearance of the heavens over thousands of years—for instance, what astronomers call "the precession



THE PROJECTOR OF THE CONSTELLATIONS

Images of the constellations are projected by the battery of lenses at the top, those of the planets are moved across the heavens by lenses in the disks at the right

of the equinoxes." Once they had seriously begun their task, it was decided that the Planetarium should be no elaborate toy, but have a permanent scientific value, which even practical astronomers should find of use for their demonstrations. When used for the latter purpose, it is provided with an attachment by which the names of thirty of the largest constellations of fixed stars including all those of the Zodiac—the Lion, the Fishes, the Goat, and so on—can be flashed onto the screen sky so that the uninitiated may learn the names that astronomers use. One great departure from realism was purposely introduced—the sun is less brilliant than it appears in reality—because it is desirable that its motion by day, relative to the brightest fixed stars, should be evident.

Stars from a Porcupine's Back

From the illustration it will be seen that the whole projection apparatus is in two parts. One part looks something like a porcupine's back. At the end of each "quill" is a group of lenses. The function of this part is to project the above-mentioned photographs of the fixed stars. The other half consists of a large glass cylinder. Inside the latter are a series of rotating disks, one each in turn for the sun, moon, Mercury, Venus, Mars, Jupiter and Saturn. The planets Neptune and Uranus are not shown by the Planetarium, as they are not visible to the eye. Each of these disks revolves in a different way, corresponding to the motion of the body it represents, and moves the projection lens which throws the image of the planet onto the artificial sky.

Two kinds of rotations are possible. One shows the motion of the heavens—for a complete day—executed in four and a half minutes or in two minutes or fifty seconds as happens to be desired. In this case the sun and moon rise and set. The other depicts the motions of the heavens for a whole year, and reviews all the changes in a period of four and a half minutes or of fifty seconds as is most convenient for the purpose in hand. In the latter case the daily motion of sun and moon are left out, the changes being depicted as though the earth did not rotate at all.

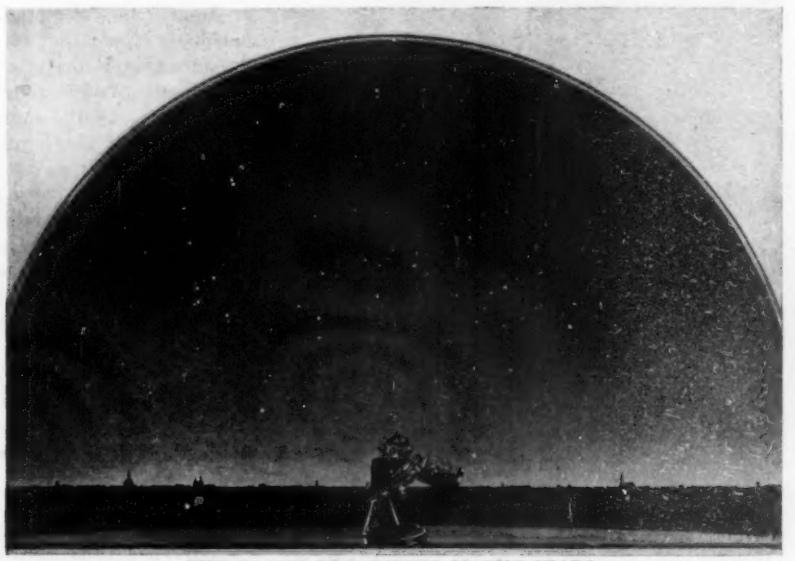
Star of Bethlehem is Seen Again

On one side of the instrument is a date indicator, which tells the exact day on which the heavens have the appearance shown by the instrument at the given moment. It is possible by this means to show the heavens as they were at any time within the past thirteen thousand years or as they will appear at any moment within the next thirteen thousand years. We can see what Ptolemy, Copernicus or Galileo saw; we can see the heavens as they were in Homer's day. We can even see the conjunction of stars which formed the so-called Star of Bethlehem at the time of the birth of Christ. More than that we can see the heavens as they will appear some thousands of years hence, when, owing to precession, the Polar Star, the one apparently absolutely fixed point in our firmament, is no longer, as now, situated directly above the North Pole.

Not the least of all the difficulties that had to be overcome in the making of this wonder, was the building of the artificial sky to test the instrument in Jena, before sending it to Munich to the Deutsches Museum. This sky had to be a cupola with no internal stays or supports that would interfere with the projection. The accompanying illustration shows how this puzzle was solved. A fine network of steel was set up and cement blown into the interstices and then allowed to set. Although, by comparison, the thickness of this steel-cement honeycomb is less than that of the shell of an egg, it possesses perfect rigidity. The absence of any objects inside this dome by which the eye could judge distance, produces a wonderful optical illusion. One cannot escape the feeling of looking at the infinitely distant real sky and at real stars.

THE HAIR NET FOR THE HEAVENS

The artificial sky in process of construction. Cement was blown into the interstices of the steel network and then allowed to set, producing the concrete dome



THE GRAND PROCESSION OF THE STARS

This interior view of the Planetarium gives some idea of its resemblance to the actual heavens and of the impression of infinite space which it creates

Our Radio Page

Listening-In on the Latest Progress of the Broadcasting Art

THIS month we are going to shift the scenes of this department from the home end of broadcasting to the microphone end. We are going to look into one of the lesser known phases of broadcasting, namely, the use of telephone lines for the purpose of reaching out for programs, and linking together a large number of stations so that the same program may be broadcast far and wide.

Most of us do not realize the problems involved and the obstacles to be overcome in this branch of communication.

Completing a long-distance telephone call is a relatively simple task today. Standard equipment and circuits are used.

Telephone Lines and Your Radio Programs

But when it comes to harnessing the telephone lines to the radio broadcasting station, we are suddenly confronted with numerous technical problems. During the last year, long distance telephone circuits have occasionally been used in connection with radio broadcasting. In these instances the telephone lines have been mustered into an unusual task, differing radically from ordinary long-distance communication.

Now, reproduced sounds have two qualities, namely, intelligibility and naturalness. In commercial telephone service, the first is of prime importance. In broadcasting, however, naturalness must also be considered, for without it there is little or no entertainment value to radio programs. We seek not only to communicate words so that they are intelligible to the listener, but to convey faithfully every intonation of voice as well as instrumental quality. This necessitates transmission over a much wider band of frequencies than that required for intelligible speech.

It has been found that a system which transmits frequencies between 500 and 2,000 reproduces speech sounds which are easily understood, although lacking somewhat in naturalness. On the other hand, in listening to the music of a symphony orchestra, response to a much wider range of frequencies is necessary.

This requirement makes important preparations necessary in order that a line may be suitable for radio broadcasting. In ordinary long-distance communication, understandable speech requires that the line be adapted to faithful transmission of a band of frequencies of about 2,000 cycles or more. Because of this fact, we are able to use one single telephone line simultaneously for as many as eight different channels of communication. When the operator connects you with Chicago, a channel of communication is placed at your disposal, and not as is generally supposed, a simple pair of wires. There may be several different telegraph messages and two or three telephone conversations going on over the same wire. These do not in any way interfere with your conversation.

When a line is used in connection with radio broadcasting, however, the very wide range of frequencies used makes it necessary to alter the circuits so that a "clean" pair of wires is available. All services ordinarily carried over the wire must be re-routed over other circuits. Furthermore, the accuracy with which this wide range of frequencies must be transmitted makes it necessary to employ special balancing equipment which overcomes the distorting effect of certain electrical qualities inherent to all wire conductors. The services of highly trained engineers are required to install and adjust the balancing equipment. Numerous tests and measurements to determine the carrying qualities of the wire line over the entire range of frequencies are made. Based on these measurements, inductances, capacities and other factors are installed so that ultimately good transmission is secured for all frequencies.

Sixty-five Engineers Necessary

The re-routing of circuits, to make a clean pair of conductors available for broadcasting, is never undertaken unless it can be done without affecting regular commercial requirements of the telephone service. The extensive preliminary tests required for broadcasting must take place at such times when regular commercial communication is at its lowest ebb. This is usually in the early morning hours.

Another fact of vital importance in preparing the telephone lines for use in connection with radio broadcasting is that the output of the lines at the broadcasting end is amplified almost countless times before it is finally radiated into the ether by the radio station. As a result, even the slightest disturbances reaching the circuit become extremely serious and, unless special precautions are taken to avoid them, are transmitted to the radio audience.

Repeaters must be installed at various points along the line for the purpose of raising the so-called volume level, wherever the attenuation, because of the long distance over which the voice currents have traveled, requires it.

If the imput on the lines were too large, it would affect neighboring circuits, so that radio programs would be heard on lines used for commercial telephony; if it were too small, so much amplification would have to be used at the receiving end, that inductive interferences from neighboring telephone and power circuits would be broadcast. Consequently, a balance between these two extremes must be struck and maintained.

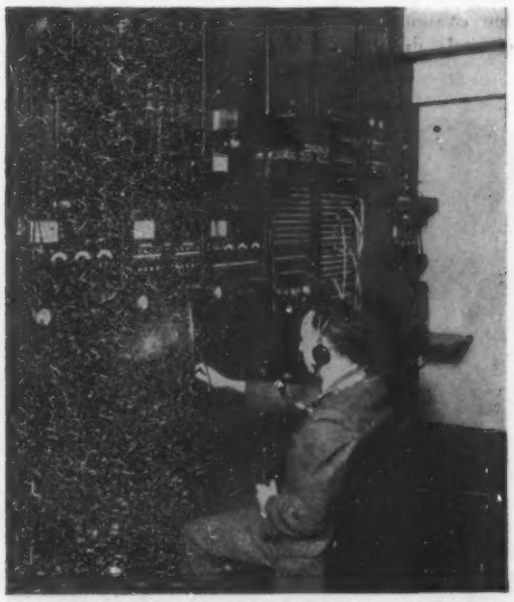
The actual work necessary to prepare long-distance telephone lines for use in connection with radio broadcasting is indicated by the broadcasting of a meeting of the National Electric Light Association last spring. Several months before the actual broadcasting, microphones were installed in Carnegie Hall, New York, to pick up speeches by Julius Barnes, President of the United States Chamber of Commerce, and vocal selections by Anna Case, Metropolitan Opera soprano. This program was broadcast through WEAF, New York; WGY, Schenectady; KDKA, Pittsburgh; and KYW, Chicago. A roll call was taken by means of the telegraph system, which always connects all stations and repeater points involved in the simultaneous broadcasting, and the names of no less than sixty-five engineers were called off. These men represented the personnel especially detailed to the task of wire telephony and broadcasting. Many of these engineers were sent long distances to their various stations. They had to be on duty not only on the occasion of the program, but several days ahead for preliminary tests.

Two Complete Sets of Wires Always Prepared

At the point where the program is being picked up, microphones are installed, special wires are run from the microphone to an amplifying equipment, operated by an amplifier expert whose task is to see that the telephone lines are furnished with the program at the proper volume level. Two complete sets of wire lines are always prepared so that should one, through some emergency become noisy, the other circuit may be resorted to without interruption. Telegraph operators are stationed at each broadcasting station as well as at amplifier and repeater points so that any difficulty detected by the engineers may be at once corrected.

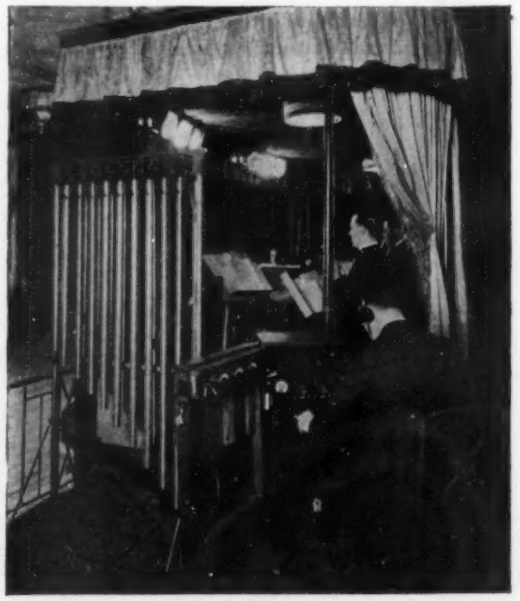
Such is the story behind those programs which are picked up at a distance from the broadcasting station, and broadcast from one or more stations.

A wider appreciation of these problems and of the magnitude of the task involved would make clear why more broadcasting with the aid of telephone lines is not undertaken.



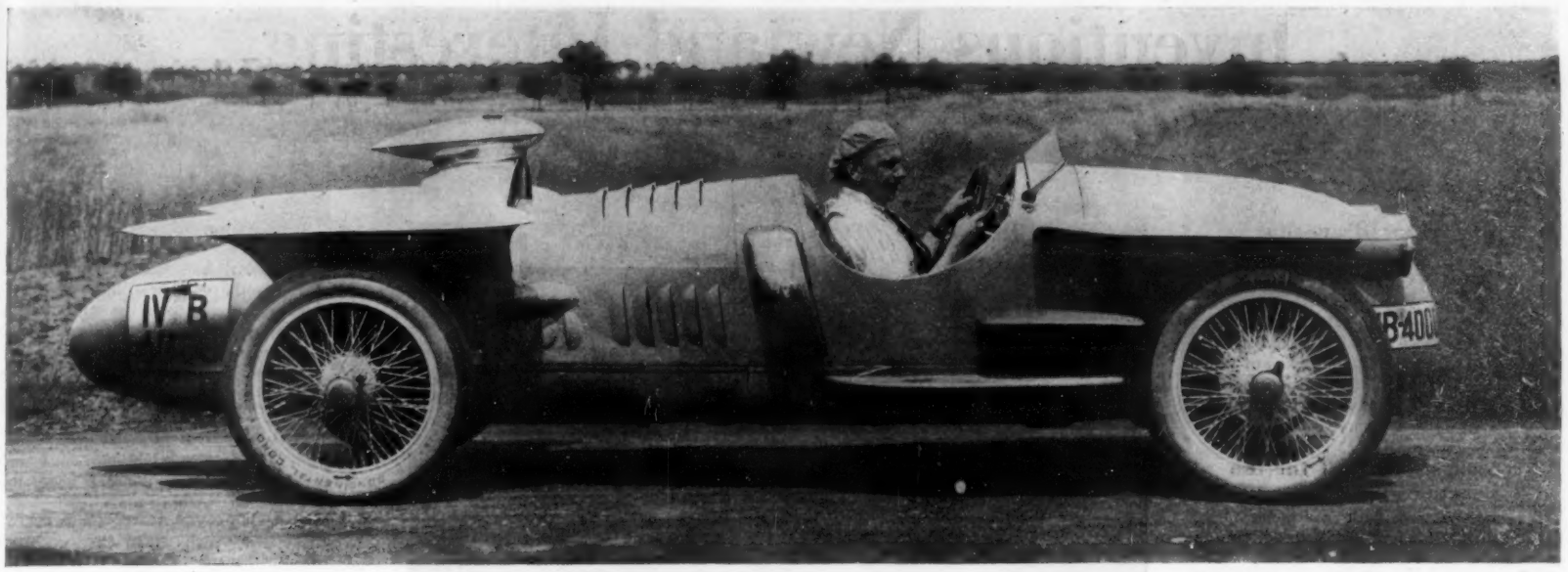
CONTROL ROOM OF STATION WEAF, NEW YORK

Out-of-the-studio programs sent in over telephone lines are received here, amplified to the proper sound level and then sent to the transmitting station about a mile away for broadcasting



BROADCASTING OVER TELEPHONE LINES

Picking up the fascinating strains of Vincent Lopez's Hotel Pennsylvania orchestra and sending them over the telephone lines to the WEAF control room to be broadcast far and wide



Streamline Bodies Save Power

By J. H. W. Kerston

IN one sense the automobile is a kind of submarine. It moves along the bottom of a deep ocean of fluid—the air.

The designers of real submarines, unlike the designers of motor cars, are careful to give the under-water craft a shape especially designed for smooth progression through its fluid medium. The fishes and the birds long ago arrived, by some process of evolution, at much the same efficient shape.

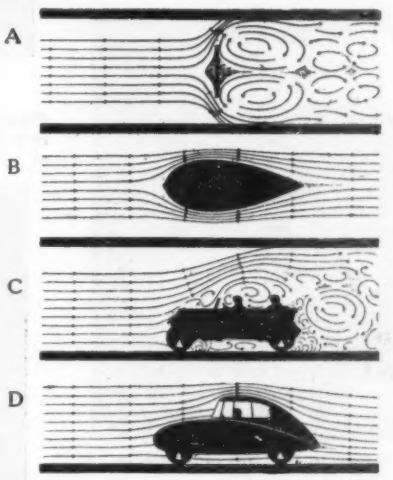
Why should we neglect to apply these principles to the motor car? Why not imitate the shape of the fish, the dirigible airship, the fast-flying goose?

Suppose that you could actually see the motion of the air around your car, just as you can stand at the bow of a ship and watch the eddies that whirl and hiss and tumble as the craft moves through its fluid medium. You would see very clearly just how your car wastes its power in setting up cross-current eddies of air.

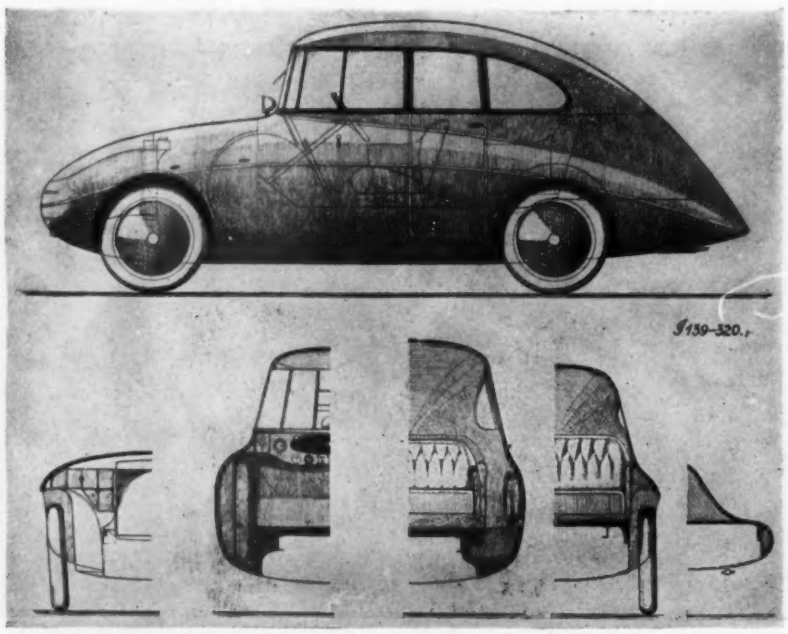
In the case of the fast racing car the air resistance to forward motion is extreme, but it is quite large enough to be worth attention even in the case of the ordinary touring car. At twenty-five miles per hour the head resistance of an ordinary car, due to its motion through the air, may amount to more than half the resistance due to mechanical friction within the mechanism. At forty miles per hour the two resistances are almost equal; while at fifty miles per hour the resistance due to forcing this rough, irregular body through the air is even greater than that due to the mechanical friction caused by the motor, the transmission and the running gear.

The car bodies illustrated on this page were made in Germany, following the designs of Paul Jaray, the eminent airship engineer. It is claimed that these bodies have reduced the power losses due to atmospheric resistance by about sixty percent at ordinary speeds. This would mean, other things being equal, that the driver of such a motor car would have to pay for about a third less refillings of gas than the driver of a conventional model.

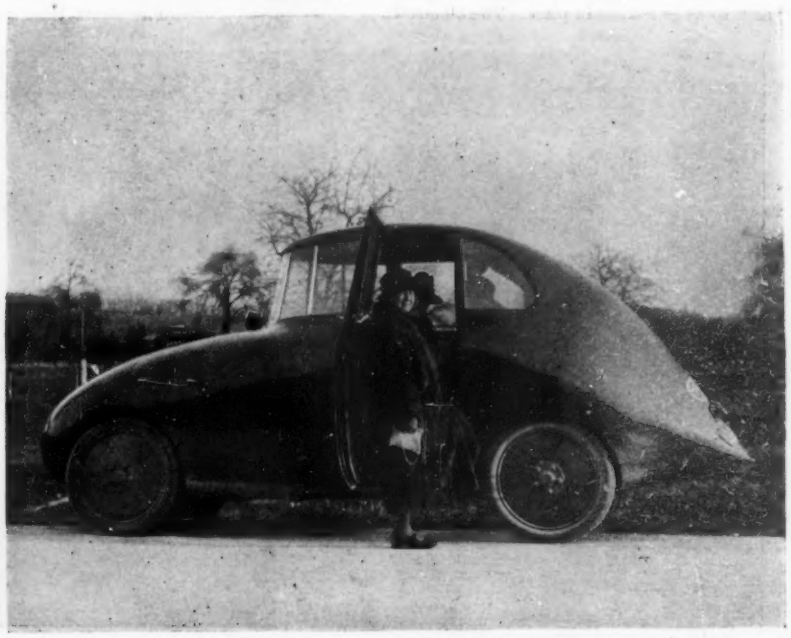
Fourteen motor-car manufacturers in fourteen different countries are reported to be providing these Jaray streamline bodies as optional equipment with their cars.



The top diagram, marked A, shows the air currents around a flat disk. B is a perfect streamline, the air currents being symmetrical. C shows the intense air disturbance—which means resistance—caused by an ordinary automobile body. The Jaray body, shown at D, creates much less resistance



If the passenger is smoking, the smoke blows out the little window in the wind shield. The peculiar streamlines of the car create air eddies which produce a suction in this direction



Note how the wheels are set into the body to decrease their resistance. In ordinary cars the air resistance of the four wheels alone may equal that of the entire streamline car

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

A Help in Diagnosing Engine Trouble

A KIND-HEARTED inventor (undoubtedly inspired by the troubles of his own pet "Lizzie") has stepped into the breach and devised a stethoscope for diagnosing such internal troubles as are often found after cruel time has taken a hand in the running of a heretofore perfect motor. The picture tells the story.

Stethoscope for the automobile

A Lamp and Grill for the Small Apartment

ONE room and bath apartments have come to stay and here is a device that goes the kitchenette one better. The "Grillite" is a reading lamp and an electric grill in one. As a lamp it is artistic in design, a worthy ornament to any home no matter how sumptuous. As a grill it is the equal for quick efficient heating of any on the market. The construction is clearly shown by the illustrations.

Attractive and useful lamp and grill combined

A Window Shelf That Needs No Mechanic

IN brief, this shelf is a telescope affair with two end lugs which engage with the sash so as to hold it in place. The all-metal construction means that the shelf is strong, neat, and will not warp from the moisture of plants. The telescopic feature enables the shelf to be extended to any length within its scope, so as to fit any standard window. When used in an ordinary two-sash up-and-down window, this shelf is placed half way up on a level with the sash lock. In several ways this is a better location than on the window sill. By utilizing the thickness of the sash the width of the shelf is reduced to a minimum. The shelf does not project so far into the room, and the draperies hang straight. Furthermore, the view is less obstructed.

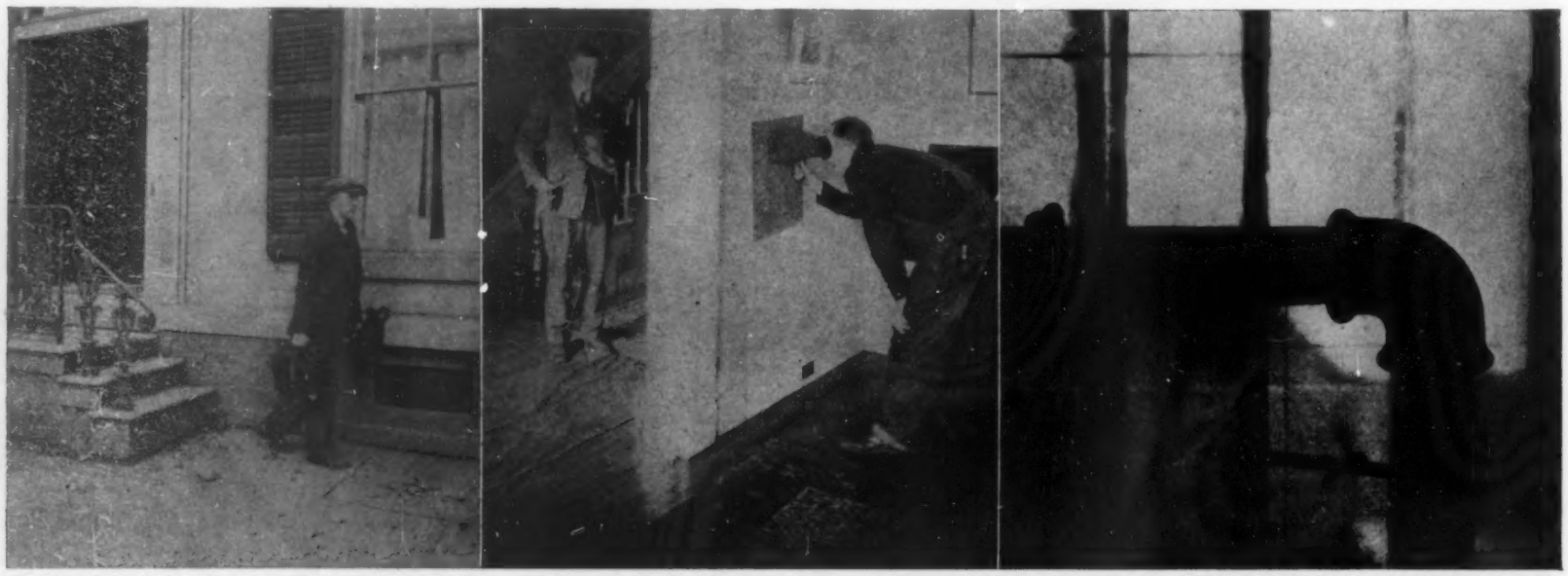
Window shelf that needs no mechanic to adjust

Unique Use for X Rays

PLUMBERS spend a large share of their worktime attempting to locate pipes and fixtures hidden within walls and floors. Electricians often find it extremely difficult to locate wires with which they desire to make connections.

If you possess a reversed iron holder you can put your electric iron in the horseshoe of the holder and you have a perfectly good electric stove

The new portable X-ray apparatus operates directly from the standard electric light fixtures of the house. The workman unscrews an electric light bulb from some convenient fixture, screws the plug of the flexible cord leading to the X-ray apparatus into its place, and starts the apparatus. He then sends his helper around to the other side of the partition with a fluoroscope in hand.



By the use of this X-ray device the nature of a piece of complicated plumbing is at once revealed; the location of an electric wire which is being fished for is made "as plain as day"; while the exact spot where some timber ends, and even the nails which attach it, are at once apparent. The entire outfit weighs but twenty pounds. It is handled with usual caution as to breakage, but its operation demands little more skill than the operation of a simple radio receiving set

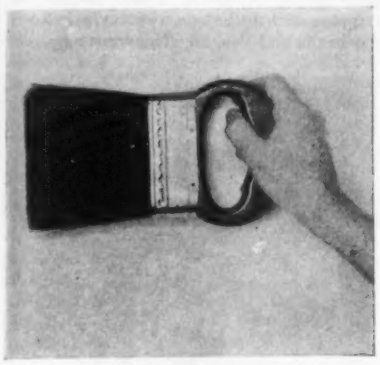
Bath tub turned into laundry tub

A Wringer for the Bath Tub

IN small apartments, even the bath tub may be requisitioned for laundry use. A wringer which is secured to the tub with special clamps is illustrated above. A clothes basket receives the damp clothes from the wringer.

New Heels for Old

IT is no longer necessary to send shoes to the cobbler to have the heels straightened, or to wait in his shop while such repairs are being made. Interchangeable heels are now provided to fit any shoe and they are easily attached or detached by a simple forward or backward pressure of the fingers. Two interlocking plates within the heel hold it in place. The plates are attached to the heel leather by rivets.



A labor-saving brush

Makes Painting Easy

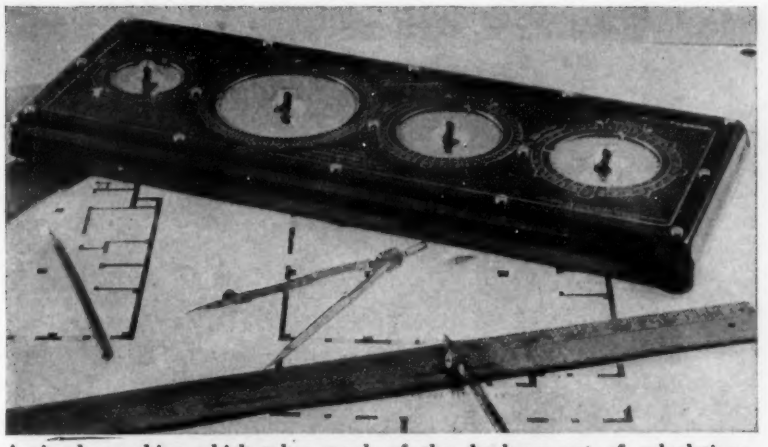
THE old-fashioned paint brush made it impossible for any hand and wrist to use it in a free, natural motion.

The handle illustrated can be held in the palm of the hand and there is said to be no strain on the fingers or wrist.

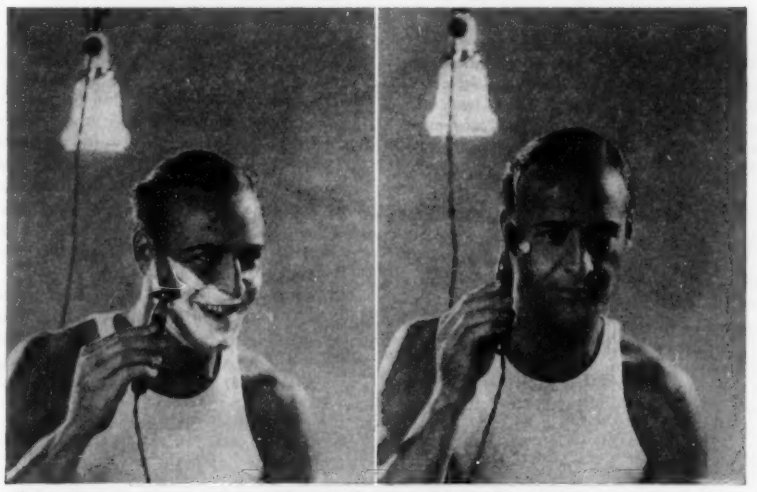
Puts Speed in Window Washing

IN the window washing brush illustrated here windows can be washed quickly as it is unnecessary to change the brush for a squeegee. The squeegee is attached to the brush as shown.

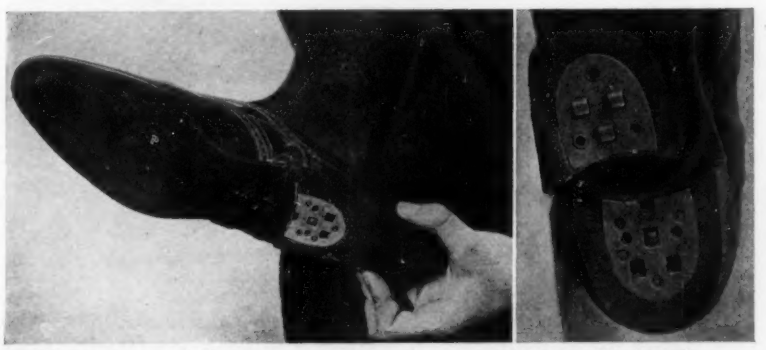
A combined brush and squeegee



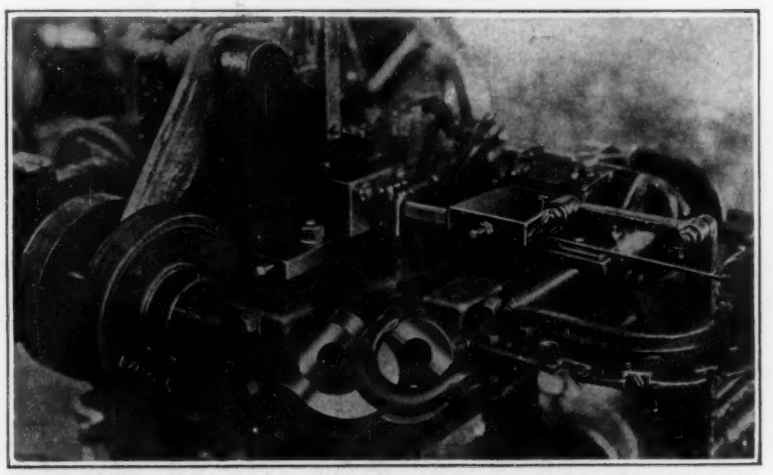
A simple machine which takes much of the drudgery out of calculations. It is valuable for architects or draftsmen. As will be seen by the illustration, there are few moving parts. The price is moderate



This electric razor and attachment for massaging the skin is a help for the busy man



The appearance of the shoe is not changed in any way when this interchangeable heel is used as it fits snugly and forms a perfectly smooth surface the entire length of the heel



The operation of this device will be readily understood by reference to the illustration. This angular transmission is noiseless and gets away from bevel gears. The drive is extremely flexible

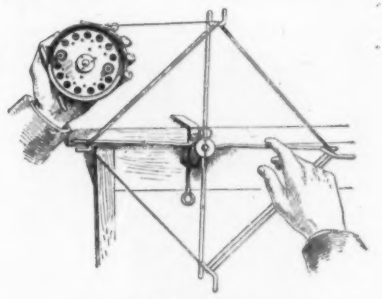
Thermometer carried like a fountain pen

A Thermometer Case

THE case illustrated holds a thermometer immersed in an antiseptic solution. A clip attaches the case to the pocket. This little device will save many a clinical thermometer from breakage.

Shave and Massage by Electricity

IN the device illustrated here a vibrating blade catches the hair and saws it off without scraping. A massage may be had afterwards with the aid of the little vibrating cup.



Dry your fishlines on a reel

Fishline Drier

THIS simple device hails from Alnwick, England, and is collapsible and packs in a small space. Each arm is numbered so there is no time lost in assembling. The method of using is clearly shown in the illustration on this page.

The drying reel receives the line from the fishing reel.

Light for the Needle's Eye

ONE of the electrically lighted sewing machines for those who sew is illustrated here. The light is made to attach to the arm of the machine directly over the eye of the needle.

An easily attached light for the sewing machine which fastens securely directly over the eye of the needle

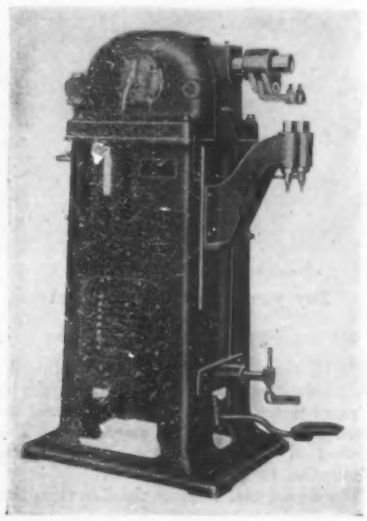
An adjustable siren

Powerful Electric Signal

THE siren is valuable for use in place of a whistle for starting and stopping work and for fire or other emergency. The fan or rotor of the siren illustrated is protected by a weatherproof housing and a screen, placed in the sound projector, keeps out foreign matter.

Automatic Adjustable Wedges

THE wedge consists of two plates—the adjustable plate and the floating plate. The adjustable plate is tapered on one side to correspond with the taper of the frame, and on the opposite side it is slightly tapered in the opposite direction. The floating plate is tapered on one side to correspond with



Smaller size of heating machine

the slight taper of the adjustable plate, and on the opposite side is straight, to line up with the driving box. The floating plate is made only slightly shorter than the distance between the binder and the top of the pedestal jaw, so that its movement is limited to approximately three-sixteenths of an inch.

Any up or down movement of the box in the frame causes the floating plate to move with it to the extent of the floating plate's clearance, and when the box moves upward the floating plate moves up, pulls itself away from the slight taper on the face of the adjustable wedge, and when the box moves down the floating plate and the adjustable wedge both move down slightly so as to pull the adjustable wedge away from the taper on the frame. This slight movement always keeps the surfaces free, and prevents sticking.

Wedges for the driving box

Amusement and exercising device very much enjoyed by the children

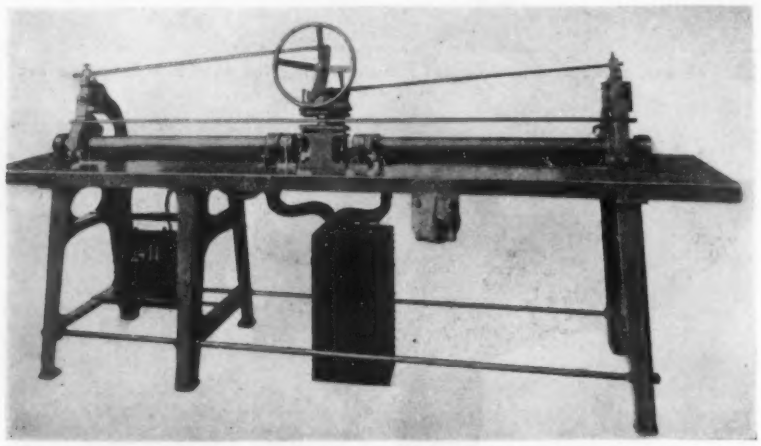
Electric Heating Machines

WE illustrate on this page the electric heating machines. The smaller machine is designed to braze a flange to a tube or similar work. It is quick and positive. The larger machine is designed for the heating of metallic screen frames for the purpose of instantly flowing solder the entire length of the frame into the corner where the metal-strip ends meet.

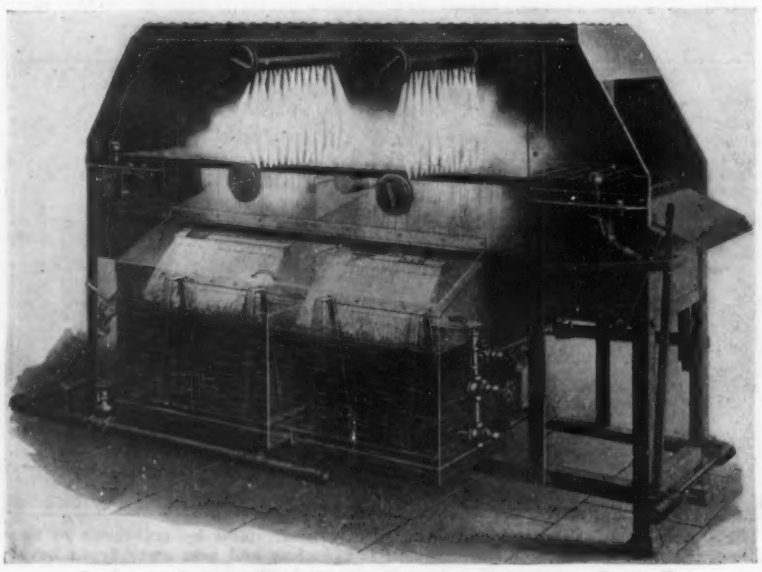
The Merry-Go-Bob Pleases the Children

THE Merry-Go-Bob is an indoor or outdoor amusement and exercising device for children up to ten or twelve years of age, for home playgrounds, playrooms and kindergartens. The principle is new, absurdly simple and safe—an inclined vertical axis, a crank pin at the top with steel straps connecting to the horse-head rocker bars. No gears, chain or belt.

Sitting comfortably on the machine, the children by alternately pulling with the hands and pushing with the feet, propel themselves around and around at a thrilling speed with about a six-inch rise and fall at every revolution.



Larger size of electric heating machine used for screen frames



A time-saving machine for washing metal parts mechanically

Quick method of removing superfluous hair

Going the Chinese One Better

NOT long ago a Chinese skin specialist made the acquaintance of an American skin specialist while visiting one of our medical colleges. The Chinese doctor told the American doctor of the ancient Chinese method of twirking out hairs with a cord.

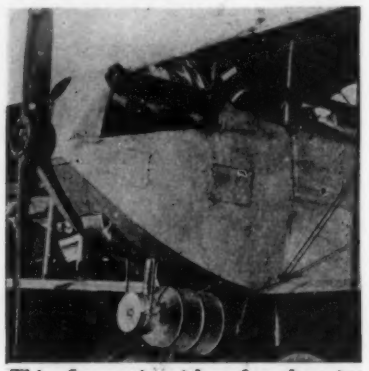
The American doctor set to work and improved on the primitive Chinese method. In place of cords he used rubber bands which grip the hairs more securely.

The rubber bands are so placed on the movable frames that there is a "V" between them. As the scissor frame is closed the point of the "V" moves toward the handles, trapping each little hair, twisting it between the bands and yanking it out instantly.

A device called the optimeter used for measuring, checking and inspecting quality products by comparison with a known standard

A Washer for Metal Parts

THE mechanical washer illustrated here does away with the slow method of washing each part by hand. The work is placed on the moving conveyor which passes through a series of fixed sprays operating from above and below, and emerges from the machine thoroughly washed and, in the larger machines, rinsed if desired.



This fire extinguisher for the airplane hails from France

This gigantic slide rule really works

A Gigantic Slide Rule

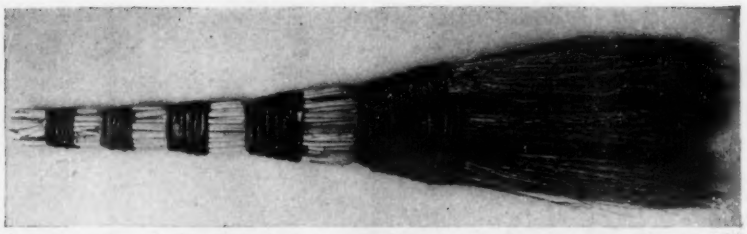
A SLIDE rule is rarely over a foot long, so when we see one six or seven feet in length we must class it as an advertising stunt. The rule illustrated is slidable and can be used for making calculations equally as well as can the engineer's desk companion.

New Brooms for Old

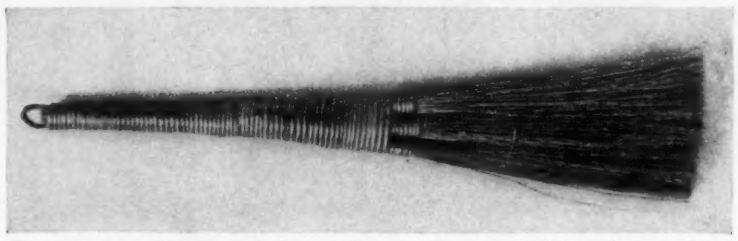
THE hearth broom illustrated on this page is unique in that it resembles in construction an early Nineteenth Century broom, now on display in the Metropolitan Museum of Art. Like its prototype it is sturdily made. It may be had at house-furnishing stores.

A "One-piece" Boat

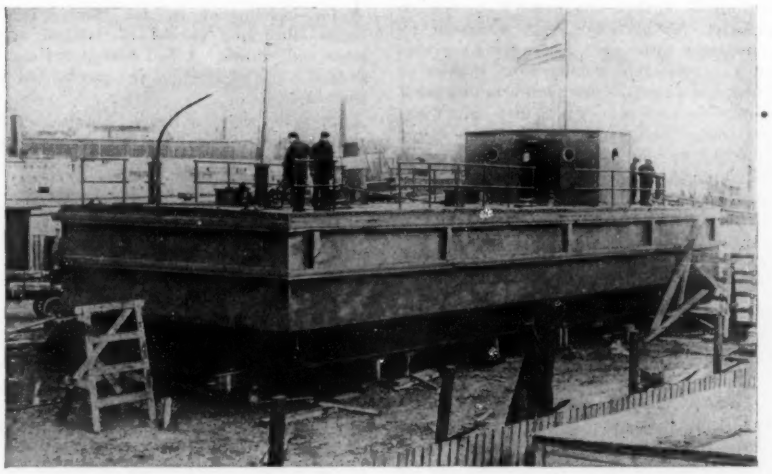
THERE was recently constructed at Providence, R. I., a rivetless and seamless steel tanker. The entire frame and skin was welded so as to make a construction which can be compared to a monolithic building. Even the deck and wheelhouse are all welded electrically. There have been other vessels constructed in a similar manner but not without more or less riveting in certain parts.



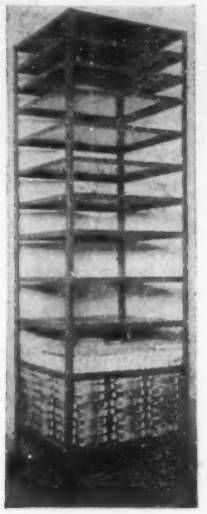
American hearth broom of the early Nineteenth Century on view in the Metropolitan Museum of Art in New York City



Brooms of similar construction as the one above are sold regularly in house-furnishings and department stores



In this one-piece boat even the deck and wheelhouse are electrically welded together. This tanker is entirely rivetless and seamless



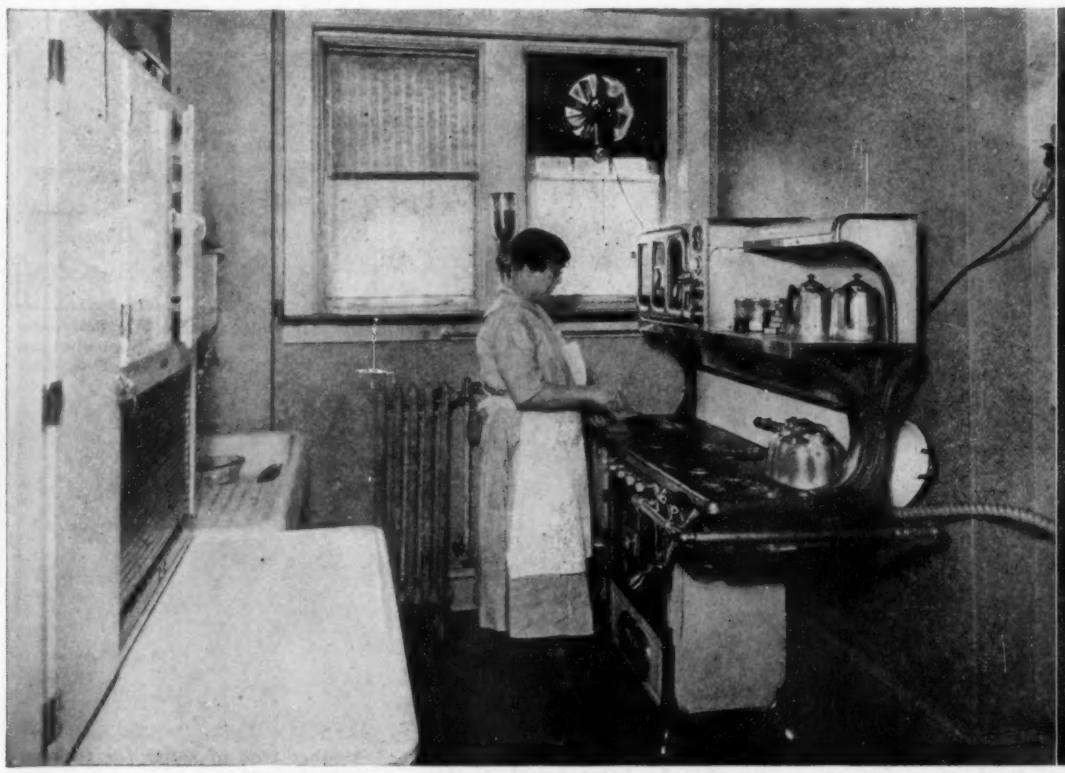
Useful stock rack unit for finished stock

All-metal Stock Racks

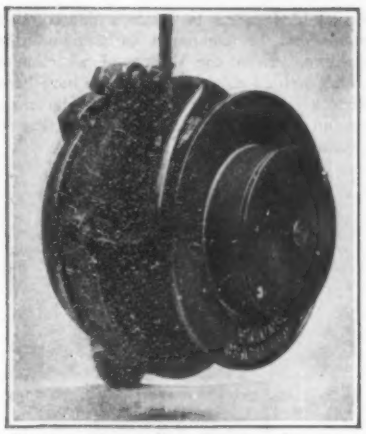
IN most manufacturing plants the keeping of small stock is troublesome. The General Electric Company have solved the problem satisfactorily by using all-metal stock racks like the one shown. These racks conserve space and keep the stock in excellent order.

An Easily Installed Ventilator

A KITCHEN free from the smoke of cooking is most desirable. This condition can be attained by the use of a small ventilating fan which can easily be installed in any window. All that is required is two metal strips fastened by four screws to the frame of the window. The fan is readily removed. Thus, it can be used in the kitchen in the daytime and in a bedroom at night.



This portable ventilator is easily installed in any window. The illustration at the left shows it in use in the kitchen. The illustration at the right shows it about to be placed in a bedroom window.



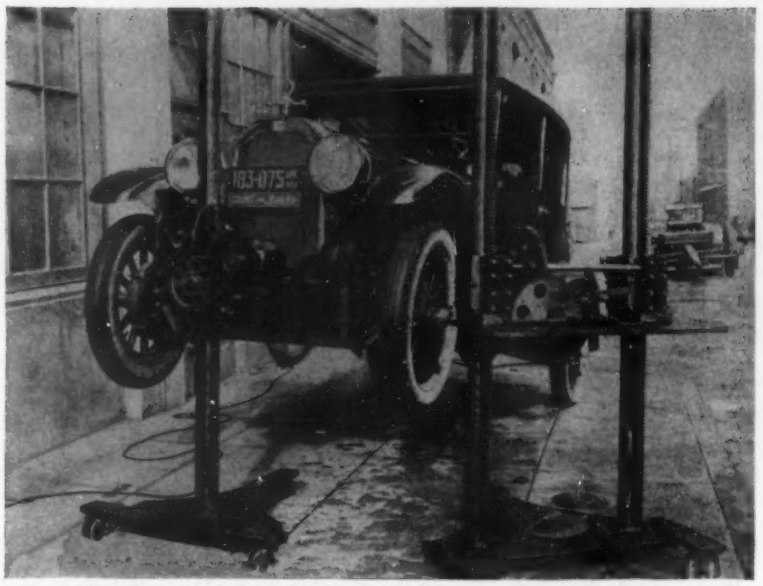
When the trolley leaves the wire this retriever instantly pulls the pole down again

Trolley Retriever

BY means of the invention illustrated above, trolley car passengers may be spared the unpleasant bumping and delay caused by the overhead trolley pole jumping the wire. When the wheel leaves the wire the "Trolley Retriever" instantly pulls the pole down and it cannot rebound. A pull of the rope rewinds the retriever spring. Resetting can be done while the car is moving.

A novel and sanitary method of putting up lozenges

A handy little implement for cutting the potatoes known as *gaufrette*



By the use of these hoists automobiles may be easily lifted

The centrifugal dogs are uniform in action throughout its revolution. There are no springs to weaken and cause it to act too quickly. All parts are easily accessible by removing a cotter pin. There are no springs on the revolvable members to weaken or break and cause the mechanism to lock itself so that the rope cannot be pulled out. When the trolley jumps off, the retriever spring acts as a cushion to stop the momentum of the rope reel, thus making the mechanism smooth in action.

Sanitary Lozenge Carrier

A ST. LOUIS concern is putting out throat lozenges in a sanitary package such as the one illustrated here. Each lozenge is wrapped into a continuous ribbon of paper.

Some Useful Potato Cutters

THE French are past masters in the art of frying potatoes in unusual ways. Both the devices shown on this page are for making *gaufrette* potatoes.

The implement so shapes the potato slices that the surface exposed to the hot fat is greatly increased. The product is a rich brown and very tasty.

The cutter shown in the right hand column is more speedy.

Handy Automobile Hoists

IT is often desirable to lift up automobiles for examination or for storage. The hoists illustrated consist of vertical steel posts with a rack. A half horsepower motor does the lifting through the mechanism of shafts and gears.

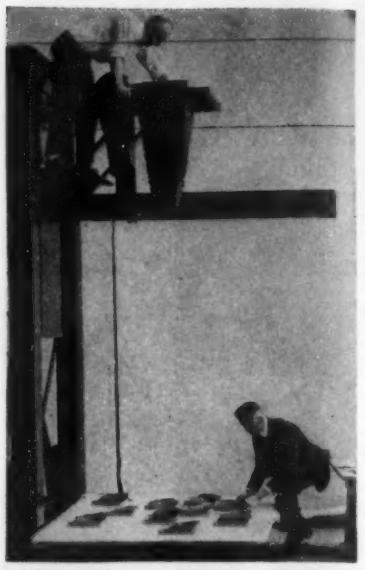
Especially designed hooks are attached to the platform so that either end of the car, or the whole car can be raised or lowered as desired.

Doughnuts Baked, Instead of Being Fried

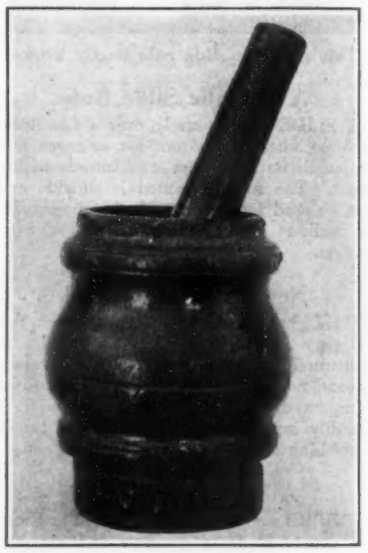
MANY persons, who would ordinarily like to eat doughnuts and other cakes of similar type in restaurants, hesitate because of the disagreeable, rancid taste often found which is due to frying in fat.

Due to the construction of the machine illustrated, the doughnuts are baked, and not fried, in corn oil or olive oil, instead of ordinary fat. The dough is placed in each set of baking compartments by means of a dough-feeder; the top of the baking compartments closed; and the entire compartment turned around; thus insuring an even baking on both top and bottom of the cakes, which can be turned out at the rate of about 1,000 per hour. This device makes an excellent advertisement for any lunch room.

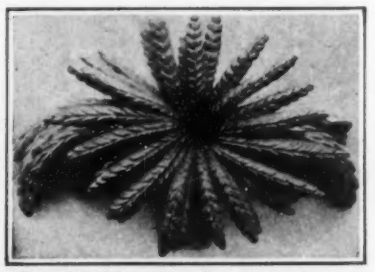
The delicious doughnut is made more digestible by being baked in this device rather than by the old-fashioned method of frying in deep fat



Photographing with the camera inverted



Old wooden mortar and pestle on view in the Metropolitan Museum of Art in New York City



Remarkable example of wood carving on view in the Metropolitan Museum of Art in New York City

Another type of cutter for forming potatoes and vegetables into fancy shapes

Protect Your Baggage

IN the handbag shown here the handles can be turned inside the bag, when the bag is checked, thus eliminating the possibilities of its being carried off by thieves. Only the owner, by unlocking the bag, can get at the handles on the inside.

Traveling bag in which the handles can be locked inside

The Versatile Milk Delivery Truck

A REMARKABLE milk delivery truck has been put on the market by a Detroit manufacturer. This truck drives either from the running board on the side, or from the seat in front. In order to make this possible the controls are duplicated in both places.

The delivery man who in our illustration, is shown standing on the running board has his right hand on the steering lever. His left hand by means of short levers, controls the electric drive. His right foot stands on the brake lever. The latter takes a peculiar form. It is a short horizontal board, about six inches wide and eighteen inches long. Under its center is a pivot or axis. This enables the foot of the delivery man to depress or elevate it.

In front, the same controls are duplicated. Thus the delivery man can hop on the most convenient part of his truck, a valuable feature to a man who must frequently jump down to deliver bottles of milk.

Testing chronometers in the United States Naval Observatory

An Automobile Road Marker

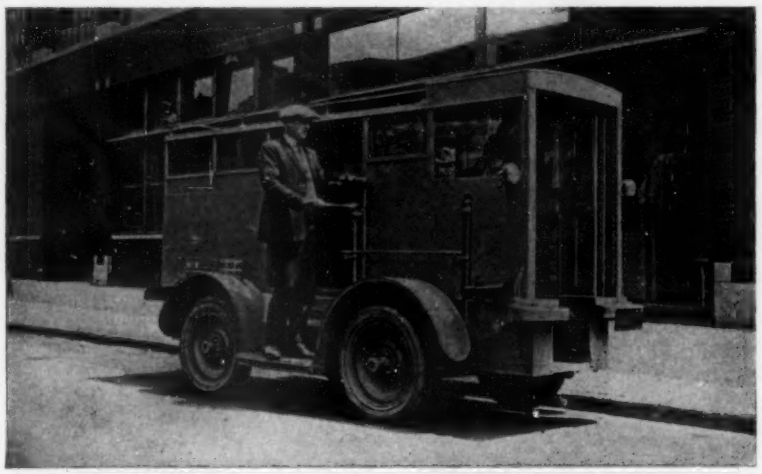
WE have been favored by Mr. A. C. Lagerwell, County Engineer, Shawnee Company, Topeka, Kansas, with a picture of a new device for marking road center lines. The marker can be attached to the running board of a light truck, as shown. Paint flows by gravity feed from the barrel in the truck.

The paint is applied by the marking wheel which is covered with felt.

The cost without paint is about 50 cents per mile. The amount of paint necessary for a line of 3½-inch width is about three gallons per mile. The size of barrel in the truck is such that a day's supply can be carried at one filling. The device may also be adapted to maintenance and refilling of the longitudinal joints in concrete pavements.

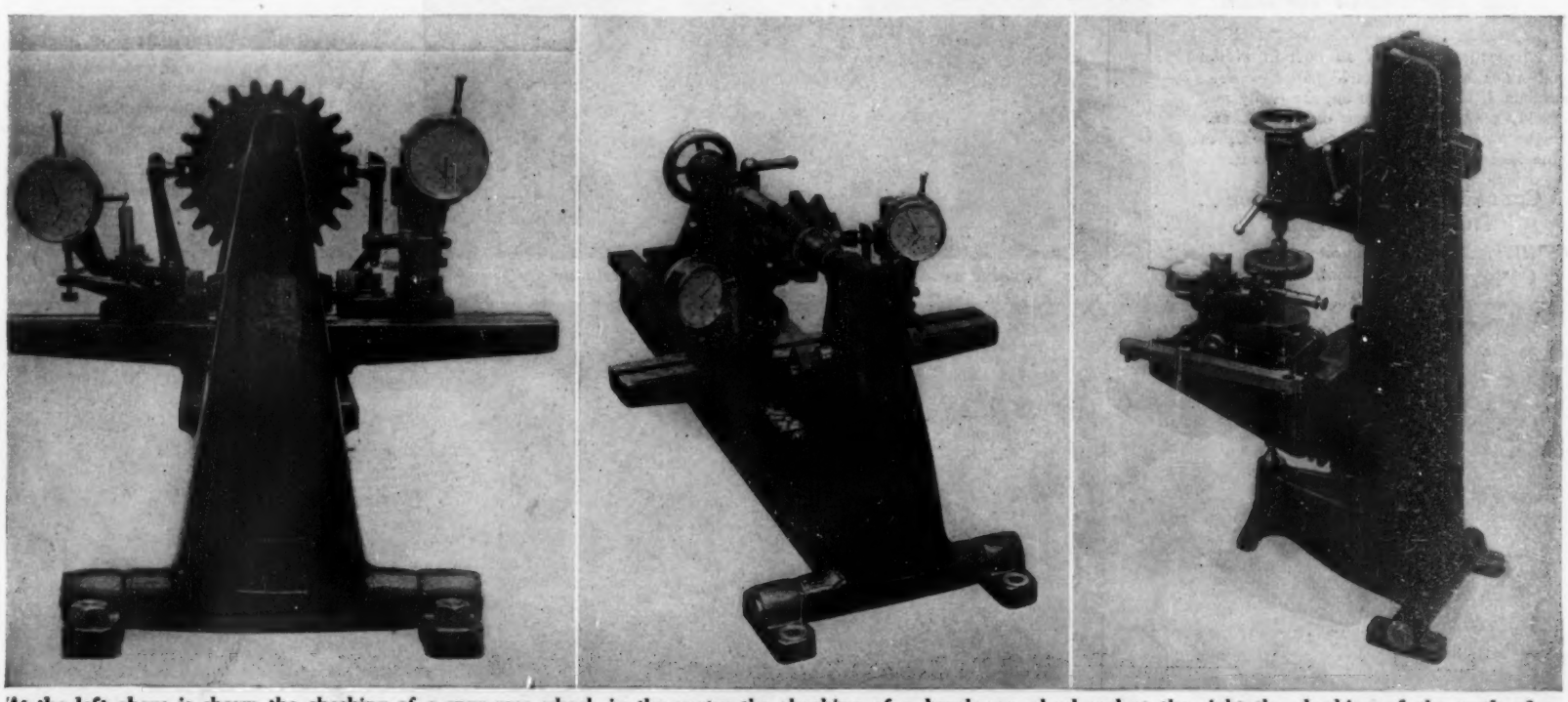
Gear Testing Machines

THE gear testing machine shown in our three pictures comes from Switzerland. The left-hand picture shows the checking of a spur-gear wheel which can be tested for the profile of the tooth, the concentricity of the teeth with respect to the axis and the uniformity of pitch. The middle illustration shows the testing of bevel-gear wheels and the right-hand one the checking of the teeth of a spur-gear wheel.

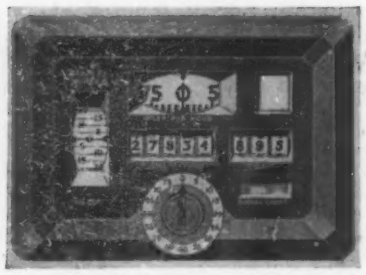


In this electric milk delivery truck the driving may be done from the running board on the side as well as from the seat in front

This roadway marker can be attached to the running board of a light truck. Paint flows by gravity feed from the barrel in the truck



At the left above is shown the checking of a spur-gear wheel, in the center the checking of a bevel-gear wheel and at the right the checking of the teeth of a spur-gear wheel



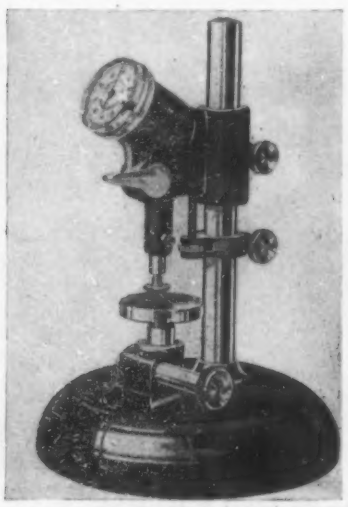
An automatic guard against exceeding the speed limit

Automatic Cut-off for Automobiles

THIS device has a lock which cuts off the ignition at a designated speed. It also warns the driver when within two or three miles of the speed limit. A gradometer indicates the grade of hills, which is important in ascertaining the conditions which call for more or less power. Other dials indicate speed per hour and trip mileage. There is also a lock as a protection against theft.

Dial Bench Gage

THIS clever little dial gage is made by a large tool manufacturer of Athol, Massachusetts. It is designed for bench work and its many adjustments give it a wide range of usefulness. Variations in thousandths

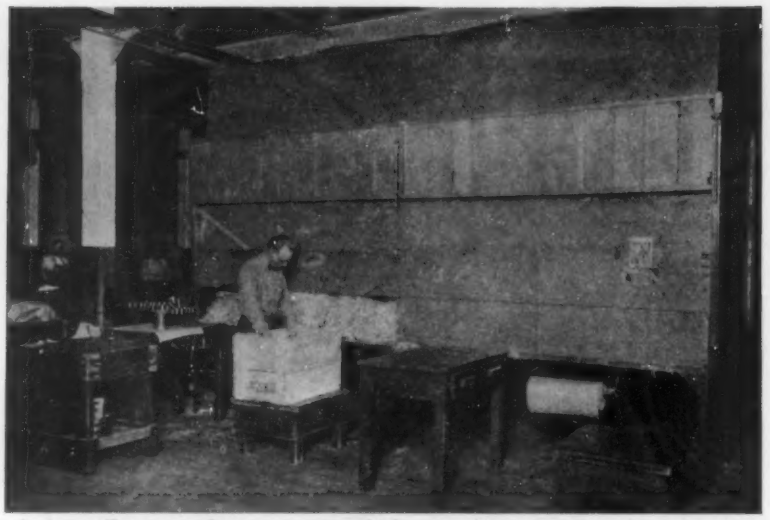


A dial gage designed for bench work

and half thousandths of an inch in widths and thicknesses of metal, paper, veneer, cardboard, fabric, and so on, are easily and quickly read with this new dial gage. The height when set for maximum capacity is nine inches and the weight six pounds.

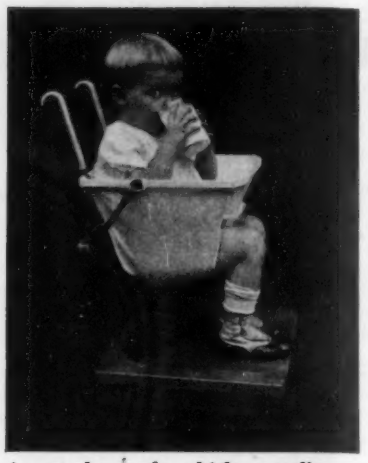
Connectors and Fittings for Tubular Conductors

THE fittings and connectors illustrated greatly simplify the work of installing outdoor station bus structures. They have made a quick and inexpensive clamping process. Conductors made of iron pipe-size copper or aluminum tubing or standard iron pipe may be joined at various angles; branch-offs may be made; and the tubular conductors may be connected to disconnecting switch terminals, oil circuit-breaker studs and bare copper conductors. The clamps are so designed that electrically they will carry the same current as the pipes which they connect, and mechanically carry the stresses to which they would ordinarily be subjected.



A very efficient packing room in which everything necessary for wrapping small articles is near at hand

Tubular conductors for outdoor station bus structures

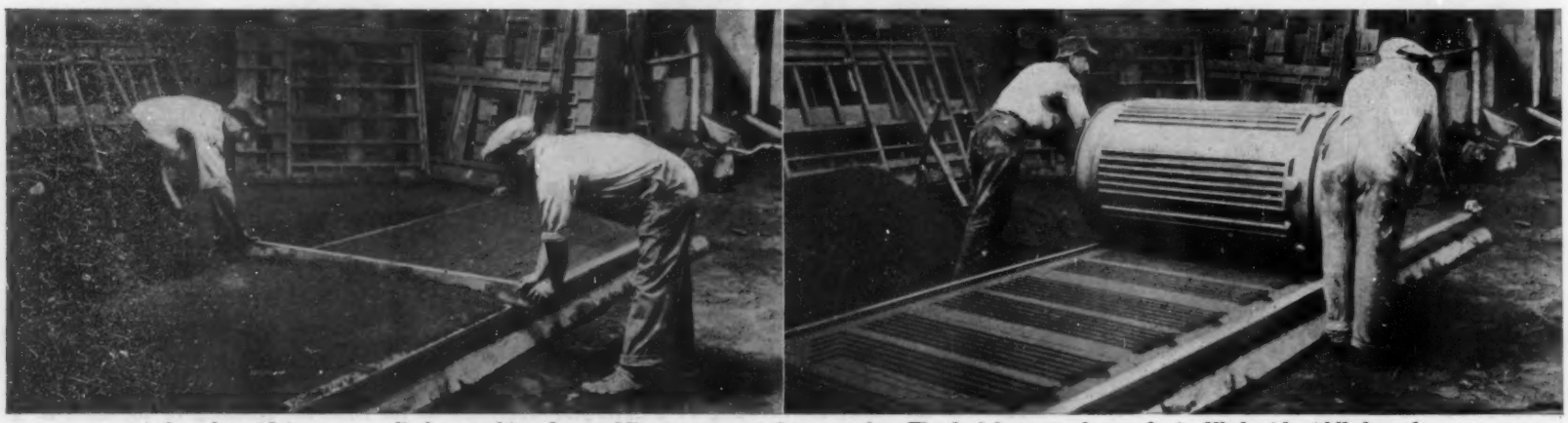


An attachment by which an ordinary chair becomes baby's high chair

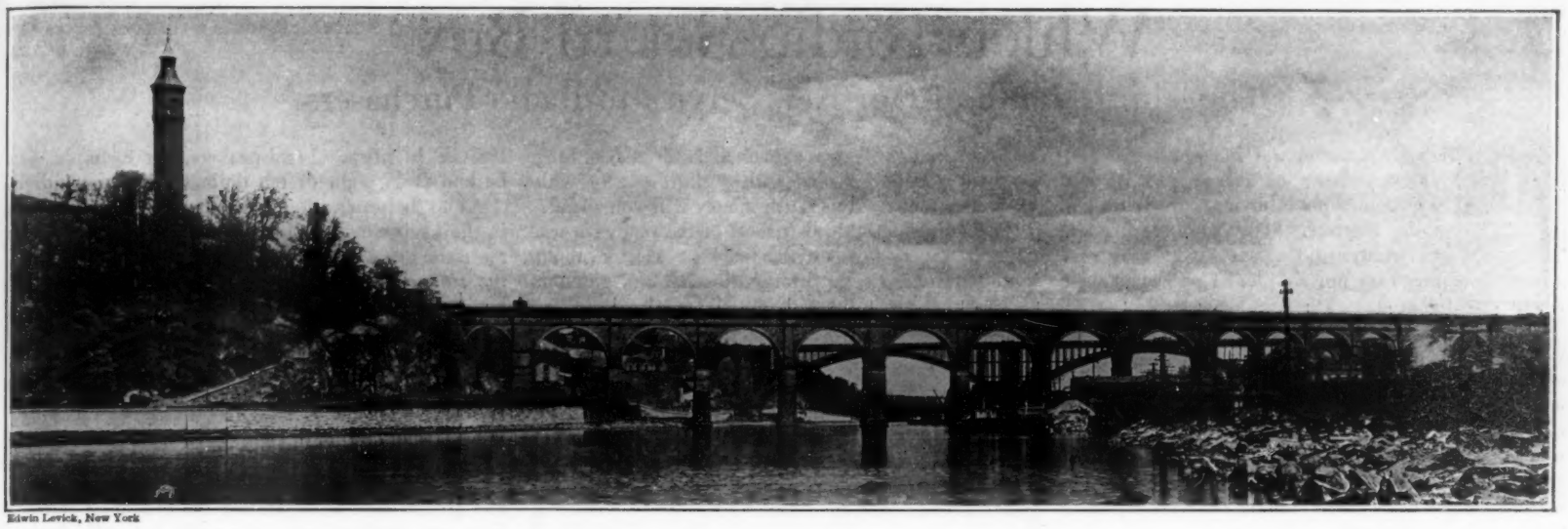
A hard blow stamps the number on the metal

Numbering Machine for Metal

WE are familiar with numbering stamps for paper and now we have one for metal. The machine numbers consecutively by depressing the lever shown at the right of the illustration. A hard blow stamps the number on the metal. Letter wheels may be substituted for the numerals if desired. This method is superior to numbering with punches by hand which are apt to give an irregular line unless great care is exercised. The construction is necessarily very rugged.



A foundry aid is a new cylinder machine for molding gaggers and core rods. The bed between the tracks is filled with riddled sand, it is then scraped and the cylinder is rolled over the bed as shown



Edwin Levick, New York

Steel to Replace Stone

High Bridge with Its Historical Background and Architectural Beauty to Be Retained

IF the visitor to New York during the latter half of the Nineteenth Century and for the first decade of the Twentieth, asked to be shown the architectural and other "Lions" of the city, it was an assured thing that he would be driven north to the Harlem River and shown the stone aqueduct which carried the city's water supply across the valley.

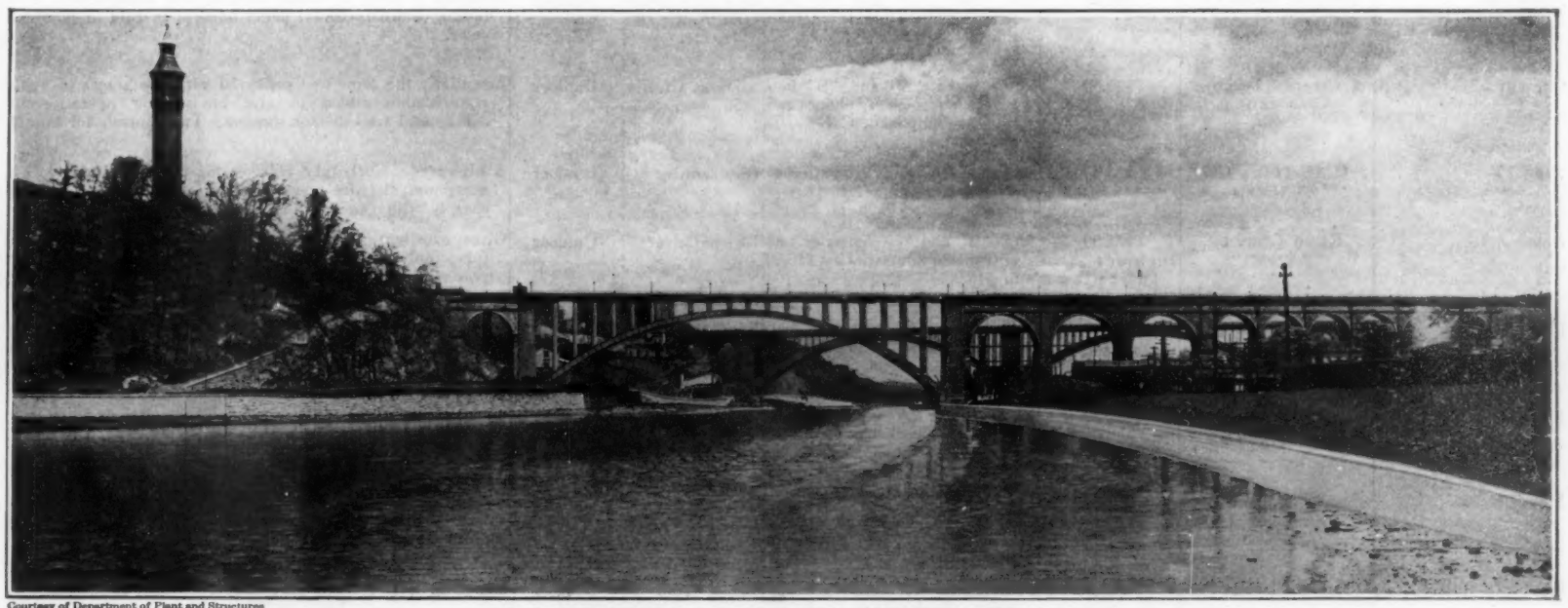
The scheme for bringing the water of the Croton watershed into New York City was duly debated and finally put through some eighty years ago. The dam was thrown across the Croton River and the impounded waters were led through a covered aqueduct to the east bank of the Harlem River, where the alternative of crossing to Manhattan by underground syphon or by bridge was finally decided in favor of the noble aqueduct, which has served the public need now for over three-quarters of a century. The water flowed through a closed masonry conduit which was carried upon a series of arches of an average span of sixty feet. At the time of its construction the Harlem River was not the important waterway which it has since become, but with the improvement of the river by dredging and straightening, which was done by the government engineers some years ago, and as the result of the natural increase of marine traffic between the Hudson and the East Rivers, the question arose as to whether the four massive stone piers which stood in the river were not so serious an obstacle as to call for their removal. The evil of the existing conditions was emphasized both by the War Department and by the general marine interests of the Port of New York, and they claimed that these obstructions would forever prevent the development of the river traffic unless the bridge were removed or remodeled.

The present city administration announced its intention to remove the bridge altogether and build in its place an underground syphon, but this proposal immediately met strong opposition from many civic organizations and from the engineering, architectural and art societies. It seemed to be the practically unanimous wish of the city that High Bridge with its historical background and its unquestioned architectural beauty should be retained, if it were possible to do this consistently with the removal of the river obstructions.

Among the many plans considered was that of building a stone arch, of less span it is true than the proposed steel arch, which was to be faced with the pressed stone work of the old arches which was in good condition. It was contended that a stone arch could be designed which would thoroughly harmonize with the existing structure. After careful investigation, the Department of Plant and Structures reported that a steel arch would be more feasible and less costly.

In the lower photograph of High Bridge the artist has drawn in the steel arch as it will appear when the work is completed.

The proposed arch will be strung from rock to rock on either shore, and there will be a vertical clearance of 103 feet at mean high water. The steel arch will have a span of 420 feet and the fact that at each end it bears upon rock will eliminate any danger of its future settlement. The Croton water will be carried in large mains supported on a system of floor-beams and stringers, and above this will be a roadway for automobile and general vehicular traffic, which will be waterproofed and finished with a concrete surface.



Courtesy of Department of Plant and Structures

HIGH BRIDGE AS IT WILL APPEAR WHEN COMPLETED

A steel arch will replace the stone arches shown in the illustration at the top of the page. This will afford an unobstructed fairway for navigation

Which Radio Set to Buy

The Third Month of Our New Service to Radio Purchasers

THIS Department was inaugurated in our January issue as an aid to readers who contemplate buying a ready-for-use radio receiver. Many such readers ask us what radio set is "best." A real answer is neither easy nor simple. This Department is our attempt at it.

The plain truth about it is that there is no "best" radio set, any more than there is a "best" suit of clothes or a "best" wife. It all depends on who wants it. One man will want only to hear the broadcasting from local stations and he will not mind wearing the two telephones and the band over his head. The next man will demand to bring in every broadcasting station in the country on a loudspeaker every night in the year.

The first man's demands are modest. He can get what he wants with almost any of the low-priced receivers. The second man is not going to get what he wants at all. No radio receiver yet devised will bring in every distant station at all times.

To decide about buying a radio receiver you have to decide, first of all, just what you want. Are you anxious for distance or content with local stations? Do you demand a loudspeaker or not? Can you erect an outdoor antenna over a hundred feet long or must you be satisfied with a short one or with an indoor loop? How much money will you spend?

The following table lists most of the ready-for-use radio receivers now on the market. Decide about your requirements, go through this list and pick out the one that meets those requirements.

Important!

If you buy a receiver, using this table as your guide, and find the results unsatisfactory please write and tell us exactly what proved to be wrong. Address The Editor, Scientific American, 233 Broadway, New York, N. Y.

All the receivers listed are worth what you pay for them and will give you good service, each within its limitations. The price you must pay for a complete outfit will be, of course, the price of the receiver itself (as listed), plus the cost of the equipment listed under accessories.

It is impossible to state the exact cost of these accessories. This depends on you. There is a wide latitude in price. Loudspeakers, for example, can be had from eight or ten dollars up to a hundred.

As to batteries, the dry-battery outfits cost less in the beginning, but for sets having three tubes or more the upkeep is less with storage batteries. Also, the storage battery (used for the filament or "A" battery) will give you greater volume, tube for tube, and more dependable operation. Dry batteries, on the other hand, are more convenient and portable.

An outdoor antenna, properly erected, will give you greater distance than a loop. Or, what is the same thing, you can pay less for your set and get the same results. But a loop set, although more expensive, will usually give you clearer reception and greater ease of separating the broadcast stations from one another—what the radio fan calls "selectivity." Location has much to do with this. Some places are good for radio, others are bad. In general, the country is better for reception than the city.

The distance obtainable with a radio receiver depends on many things. Locality is a main one. Another is the weather. Still another is the skill of the person who does the tuning. The hearing of distant stations with a given type of set *cannot* be guaranteed.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
CROSLEY 50	CROSLEY RADIO CORPORATION	$14.50	One tube, "A" and "B" batteries, antenna equipment and phones. Cost from $18.00 to $30.00.	Single circuit regenerative	Outdoor	This is a simple one-tube outfit built to sell at as low a price as possible consistent with good results. Will bring in stations up to 500 miles away with headphones.
CROSLEY 50 P	CROSLEY RADIO CORPORATION	$18.00	One tube, "A" and "B" batteries, phones and length of flexible wire. Cost approx. $17.00.	Same as Crosley 50	Outdoor	This is the Crosley 50 made up in portable form. Should be used with dry battery tubes to keep down the weight.
CROSLEY 51	CROSLEY RADIO CORPORATION	$18.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	Same as Crosley 50 plus one stage amplifier	Outdoor	Same as the Crosley 50 with one stage of audio amplification which gives greater volume of sound.
"SHEPCO" All Purpose	THERMIODYNE RADIO CORP.	$21.00	One tube, "A" and "B" batteries, antenna equipment and phones. Cost $18.00 to $30.00.	Experimental	Outdoor	A receiver for the man who wishes to experiment with various circuits. The leads from the various parts are brought up to a binding post panel so that many circuits may be tried by connecting the posts in different ways.
CROSLEY 51 P	CROSLEY RADIO CORPORATION	$25.00	Two tubes, "A" and "B" batteries, phones and wire for antenna. Cost $20.00 to $32.00.	Same as Crosley 51	Outdoor	Same as the Crosley 51 but fitted into a portable case.
PARAGON TWO	ADAMS MORGAN CO., INC.	$27.50	Two tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $23.00 to $45.00	Regenerative	Outdoor	Gives loudspeaker results on local stations and brings in distant stations on headphones. Single dial tuning.
MODEL R	FARAWAY RADIO CO.	$29.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	One stage radio-frequency and detector	Outdoor	Designed to bring in distant stations with headphones. Two tuning controls. Metal panel finished in gold or platinum color.
CROSLEY 52	CROSLEY RADIO CORPORATION	$30.00	Three tubes, "A" and "B" batteries, loudspeaker, phones and antenna equipment. Cost $40.00 to $60.00.	Same as Crosley 50	Outdoor	Essentially the same as Crosley 50 with two stages of audio amplification added to give loudspeaker operation on nearby and semi-distant stations. Two controls for tuning.
TYPE 224	C. D. TUSKA CO.	$35.00	One tube, "A" and "B" batteries, phones and antenna equipment. Cost $18.00 to $30.00.	Regenerative	Outdoor	A high-grade, single-tube receiver for those who wish to get maximum distance and selectivity with one tube. Tunes sharply with two controls.
RADIOLA III	RADIO CORP. OF AMERICA	$35.00 Includes two tubes and headphones.	"A," "B" and "C" batteries and antenna equipment. Cost $10.00 to $15.00.	Regenerative	Outdoor	Gives excellent selectivity and is sensitive. Uses dry-cell tubes only and will operate a loudspeaker on nearby, powerful stations.
MRC-2	MICHIGAN RADIO CORP.	$37.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	Regenerative	Outdoor	Is fitted with levers instead of the usual dials for tuning. Good for headphone reception up to 500 miles or more under favorable conditions. Three controls.
PARAGON THREE	ADAMS MORGAN CO., INC.	$48.50	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $30.00 to $50.00.	Regenerative	Outdoor	Gives loudspeaker results on semi-distant stations when conditions are favorable. Single dial tuning.
MODEL F	FARAWAY RADIO CO.	$59.50	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	One stage transformer coupled radio-frequency.	Outdoor or indoor	Simple to tune and brings in distant stations on loudspeaker under favorable conditions. Metal panel finished in gold or platinum color.
FRESHMAN MASTERPIECE	CHAS. FRESHMAN CO.	$60.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00	Tuned radio	Outdoor	Brings in local stations on loudspeaker with good tone.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
MRC-12	Michigan Radio Corp.	$62.50	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Regenerative	Outdoor	Three levers instead of the usual dials are used to control this receiver. Sensitive and selective. Will bring in moderately distant stations on a loudspeaker.
Radiola III-a	Radio Corp. of America	$65.00 Includes four tubes and headphones.	"A," "B" and "C" batteries, loudspeaker and antenna equipment. Cost $25.00 to $50.00.	Regenerative	Outdoor or indoor	Uses 1½-volt tubes, which can be operated by dry batteries, or 2-volt storage battery. Sensitive and selective. Brings in distant stations on loudspeaker under favorable conditions. Two tuning controls.
Thrdyn	Crosley Radio Corporation	$65.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Radio-frequency plus reflex	Outdoor or indoor	Gives marked selectivity and is sensitive to distant signals. Two tuning controls which may be logged for each station.
Type T	Ware Radio Corporation	$65.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $35.00 to $50.00.	Neutrodyne reflex	Outdoor	Attains maximum results with three 199 type tubes. Sensitive and selective with simple tuning by two dials. Will operate loudspeaker on distant stations under favorable conditions.
Model 9	Atwater-Kent Mfg. Co.	$65.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Sensitive and selective with two controls. Open set with apparatus mounted on a board, no panel. Brings in distant stations when conditions are right.
Paragon Four	Adams Morgan Co., Inc.	$65.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Brings in distant stations on loudspeaker with good volume when conditions are favorable.
Clear-O-Dyne Model 70	Cleartone Radio Co.	$75.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Gives loudspeaker volume on distant stations when conditions are favorable.
Fada "Neutro-Junior"	F. A. D. Andrea, Inc.	$75.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Neutrodyne reflex	Outdoor	Sensitive and selective. Tuned by two dials. Loudspeaker volume on distant stations under favorable conditions.
Tone-a-Dyne	Resas, Inc.	$78.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive. Brings in distant stations with loudspeaker volume when conditions are favorable.
Model V	Colin B. Kennedy Corp.	$75.00	Three tubes, "A" and "B" batteries, antenna equipment. Cost $55.00 to $80.00.	Regenerative	Outdoor	Designed for home use to receive local and high-powered distant stations on loudspeaker. Uses either dry battery or storage battery tubes.
Radiodyne WC-5-B	Western Coil & Electrical Co.	$80.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Brings in distant stations on loudspeaker with simple tuning control. Sensitive and selective.
Type 301	C. D. Tuska Co.	$85.00	Three tubes, "A" and "B" batteries, headphones and loudspeaker, antenna equipment. Cost $55.00 to $80.00.	Radio-frequency reflex	Outdoor	Will bring in distant stations and is highly selective. Two main tuning controls.
Brandola 3	J. F. Brandeis Corporation	$85.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Brings in local stations with good volume and distant stations when conditions are favorable.
Amrad Neutrodyne	American Radio & Research Corp.	$85.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Brings in distant stations on loudspeaker. A feature of this receiver is two-dial tuning.
Model 10	Atwater-Kent Mfg. Co.	$85.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Open set with apparatus mounted on a board, no panel. Sensitive and selective, with three controls. Brings in distant stations on loudspeaker under favorable conditions.
Model 19	Atwater-Kent Mfg. Co.	$85.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Electrically the same as Atwater-Kent Model 9 except that it is fitted in cabinet.
Day-Fan OEM-11	Dayton Fan & Motor Co.	$90.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment.	Radio-frequency reflex	Outdoor or indoor	A combination of radio-frequency and reflex circuits. Gives loudspeaker results. Easy to tune.
Model MW	Midwest Radio Co.	$95.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Simple tuning and brings in distant stations on loudspeaker under favorable conditions.
Zenith 4 R	Zenith Radio Corp.	$95.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Highly sensitive and selective, brings in distant stations on loudspeaker under favorable conditions. Three controls for tuning. Can be used with dry battery or storage battery tubes.
Day-Fan OEM-7	Dayton Fan & Motor Co.	$98.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Radio-frequency reflex	Outdoor or indoor	Clear tone, selective and sensitive. Tunes easily. Economical in current consumption.
Edisondyne	Edison Radio Corp.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Tunes easily with three dials which may be logged for each station. Separate rheostats for each tube except two audio tubes which are on same rheostat.
Electrola	American Specialty Co.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Very low "B" battery current consumption. Cushion sockets to eliminate microphonic noises. Sensitive and selective.
Model 20	Atwater-Kent Mfg. Co.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	This receiver is the same as Model 10 except that it is mounted in a cabinet.
Model N R-12	Freed-Eisemann Radio Corp.	$100.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Neutrodyne	Outdoor	Selective and sensitive. Will give loud signals on local stations and brings in distant stations when conditions are right.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
MURDOCK NEUTRODYNE	WM. J. MURDOCK CO.	$100.00 Includes loudspeaker	Five tubes, "A" and "B" batteries, antenna equipment. Cost $45.00 to $60.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective, will bring in distant stations on loudspeaker under favorable conditions.
MODEL III	COLIN B. KENNEDY CORP.	$101.50 Includes headphones	Three tubes, "A" and "B" batteries, flexible wire for antenna. Cost approx. $25.00.	Regenerative	Outdoor	This is the Model V Kennedy receiver constructed for portability in an imitation leather case with cover containing a compartment for headphones and coiled antenna wire.
MODEL VI	COLIN B. KENNEDY CORP.	$105.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Selective and sensitive, gives great volume on loudspeaker on local and semi-distant stations.
MODEL 12	ATWATER-KENT MFG. CO.	$105.00	Six tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	This receiver has the same characteristics as Model 10 with an extra tube added to give great volume on local and distant signals. Three controls, sensitive and selective.
MA 18	MU-RAD LABORATORIES, INC.	$110.00	Five tubes, "A" and "B" batteries, loudspeaker, antenna equipment. Cost $65.00 to $85.00.	Transformer coupled radio-frequency	Outdoor or indoor	Selective and sensitive, low current consumption both "A" and "B" batteries. Gives loudspeaker results on local and distant stations under favorable conditions. One tuning control.
TYPE XL-5	A. C. ELECTRICAL MFG. CO.	$115.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive. Three controls. Brings in distant stations on loudspeaker under favorable conditions.
TYPE NO. 110	FEDERAL TEL. MFG. CORP.	$117.00 Includes headphones and three tubes	"A" and "B" batteries, antenna equipment and loudspeaker. Cost $20.00 to $50.00.	Transformer coupled radio-frequency	Outdoor or indoor	One major control for wavelengths. Selectivity can be varied to suit local conditions. Sensitive on distant signals.
FADA "One-Sixty"	F. A. D. ANDREA & CO.	$120.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Neutrodyne reflex	Outdoor or indoor	Three controls for tuning. Sensitive and selective, brings in distant stations on loudspeaker under favorable conditions.
SUPER CLEAR-O-DYNE MODEL 80	CLEARTONE RADIO CO.	$120.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive. Brings in distant stations on loudspeaker when conditions are favorable.
T R F MAGNAVOX	MAGNAVOX CO.	$125.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Simple to operate as the special type of variometers used for tuning are geared to one control on the panel. Highly selective and sensitive.
BRANDOLA	J. F. BRANDEIS CORP.	$125.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	One dial control for tuning and resistance coupled amplification at audio-frequencies result in simple operation and quality of reproduction.
TYPE 6-D	EISEMANN MAGNETO CORP.	$125.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Three tuning controls. Sensitive and selective. Brings in distant stations on loudspeaker when conditions are favorable.
GRANDETTE MODEL V-50	R. E. THOMPSON MFG. CO.	$125.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $85.00.	Neutrodyne	Outdoor or indoor	Selective and sensitive. Plenty of volume on local stations and brings in distant stations on loudspeaker when conditions are favorable.
MODEL D	HOWARD MFG. CO., INC.	$135.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Gives good loudspeaker volume on local stations and brings in distant stations when conditions are favorable.
MODEL 7	PFANSTIEHL RADIO CO.	$140.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Station finder engraved on the panel materially aids in tuning stations. Gives loudspeaker volume or local and semi-distant stations.
GN 2	GILFILLAN BROS., INC.	$140.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Three tuning controls according to the standard neutrodyne arrangement. Double range voltmeter on panel. Sensitive.
M.S. 24 Melco Supreme	AMSCO PRODUCTS, INC.	$140.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive, inductively tuned with three controls. Compensating condensers controlled by dials so that various types of tubes may be used. Brings in distant stations on loudspeaker.
THERMIODYNE T F 6	THERMIODYNE RADIO CORP.	$140.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective, single control for tuning. Brings in distant stations on loudspeaker under favorable conditions.
MODEL XV	COLIN B. KENNEDY CORP.	$142.50	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Two tuning controls, brings in distant stations when conditions are favorable. Selective and sensitive.
MODEL R-100	SPLITDORF ELECTRICAL CO.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Brings in distant stations on loudspeaker when conditions are favorable.
BESTONE V-60	HENRY HYMAN & CO.	$150.00 Includes loudspeaker	Five tubes, "A" and "B" batteries and antenna equipment. Cost $65.00 to $85.00; $45.00 to $60.00.	Radio-frequency	Outdoor or indoor	Gives excellent results on local and distant stations when conditions are favorable.
MODEL N R-6	FREED-EISEMANN RADIO CORP.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Same as NR-12, listed under $100.00, above, but gives greater volume on distant stations.
RADIOLA REGENOFLEX	RADIO CORP. OF AMERICA	$150.00	Four tubes, "A," "B" and "C" batteries, antenna equipment and loudspeaker. Cost $45.00 to $65.00.	Regenerative	Outdoor or indoor	Sensitive and selective. Arranged to operate on dry battery tubes. Gives excellent volume on loudspeaker from local and distant stations when conditions are favorable.
MRC-4	MICHIGAN RADIO CORP.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Levers are used for tuning instead of dials. Sensitive and selective. Cushion sockets to cut out microphonic noises.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
RADIODYNE W C 10	WESTERN COIL & ELECTRICAL CO.	$150.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective, easy to tune. Brings in distant stations on loudspeaker when conditions are favorable.
TYPE X	WARE RADIO CORP.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $45.00 to $65.00.	Neutrodyne reflex	Outdoor or indoor	Gives best results possible with four dry battery tubes. Not adapted to storage battery tubes. Sensitive and selective. Operates loudspeaker on local and semi-distant stations.
SUPERDYNE	C. D. TUSKA CO.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Superdyne	Outdoor or indoor	Extremely selective and sensitive. Two tuning controls. Brings in distant stations.
M.S. 25 Melco Supreme	AMSCO PRODUCTS, INC.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Highly selective and sensitive. Inductively tuned with three controls. Compensating condensers mounted on panel with dials so that receiver can be instantly adjusted for different types of tubes.
SYNCHROPHASE Type MU-1	A. H. GREBE & CO., INC.	$155.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	An entirely new system of condenser mounting and dial arrangement makes tuning easy. Highly selective and sensitive. Gives loudspeaker results on distant stations.
SYNCHROPHASE Type MU-2	A. H. GREBE & CO., INC.	$155.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $55.00 to $75.00.	Tuned radio-frequency	Outdoor or indoor	This receiver is arranged for use with dry battery tubes, otherwise it is essentially the same as Type MU-1 except that an extra tube is added to make up for the lower power of dry battery tubes.
TYPE No. 102	FEDERAL TEL. MFG. CORP.	$156.00 Includes headphones and four tubes	"A" and "B" batteries, antenna equipment and loudspeaker. Cost $20.00 to $50.00.	Transformer coupled radio-frequency	Outdoor or indoor	Designed primarily for operation with dry battery tubes, but storage battery tubes may also be used. Two main tuning controls give selectivity and sensitivity.
ZENITH 3R	ZENITH RADIO CORP.	$160.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Highly selective and sensitive. Three controls. Brings in distant stations on loudspeaker when conditions are favorable. Good quality of reproduction. Dry or storage battery tubes can be used.
NEUTROCEIVER	F. A. D. ANDREA, INC.	$160.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Selective and sensitive. Three dials control the tuning. Brings in distant stations on loudspeaker under favorable conditions and give plenty of volume on local stations.
INVERSE DUPLEX Type 2-S-4	MERCURY RADIO PRODUCTS CO.	$165.00 With loop	Four tubes, "A" and "B" batteries, loudspeaker. Cost $55.00 to $75.00.	Inverse reflex	Loop or antenna	Three vernier condensers used for tuning. Selective and sensitive. Gives loudspeaker results on distant stations under favorable conditions.
D-12	DEFOREST RADIO CO.	$165.00 Complete with loop	None	Tuned radio-frequency reflexed	Loop	This receiver uses four tubes and is sensitive and selective. Brings in distant stations with good volume when conditions are favorable.
TYPE W	WARE RADIO CORP.	$175.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Three controls. Brings in distant stations on loudspeaker when conditions are favorable.
TYPE B	EAGLE RADIO CO.	$175.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Three controls with large knobbed dials make it easy to tune. Brings in distant stations on loudspeaker when conditions are favorable.
MA 15	MU-RAD LABORATORIES, INC.	$180.00	Six tubes, "A" and "B" batteries, loudspeaker and loop. Cost $70.00 to $90.00.	Transformer coupled radio-frequency	Loop	Sensitive and selective. One tuning control. Brings in local stations with plenty of volume and distant stations on loudspeaker when conditions are favorable.
STROMBERG-CARLSON	STROMBERG-CARLSON TEL. MFG. CO.	$180.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Fully up to the best standards for neutrodyne construction. Three tuning controls. Will bring in distant stations on loudspeaker.
CONCERT GRAND MODEL S-70	R. E. THOMPSON MFG. CO.	$180.00	Six tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $70.00 to $90.00.	Neutrodyne	Outdoor or indoor	Selective and sensitive. Great volume on local stations and brings in distant stations with considerable volume when conditions are favorable.
TYPE No. 59	FEDERAL TEL. MFG. CORP.	$193.00 Includes four tubes and headphones	"A" and "B" batteries, loudspeaker and antenna equipment. Cost $40.00 to $60.00.	Transformer coupled radio-frequency	Outdoor or indoor	Arranged for operation on storage battery. Sensitivity and selectivity may be adjusted to suit local conditions.
TYPE V	GAROD CORP.	$195.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	In addition to the three dials used to control the tuning, there is a double-range, high-grade voltmeter to test the batteries. Selective and sensitive. Brings in distant stations on loudspeaker when conditions are right.
OPERADIO	OPERADIO CORP.	$195.00 Complete	None	Transformer coupled radio-frequency	Self-contained loop	A portable set that includes tubes, dry batteries and loudspeaker. Brings in local stations with plenty of volume and semi-distant stations when conditions are favorable.
MODEL A	HOWARD MFG. CO., INC.	$200.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Brings in distant stations on loudspeaker with plenty of volume when conditions are favorable.
RADIOLA Super Heterodyne	RADIO CORP. OF AMERICA	$220.00	Six UV 199 tubes, "A," "B" and "C" batteries, loudspeaker. Cost $34.00 to $55.00.	Superheterodyne	Self-contained or external loop	Highly sensitive and selective. Two tuning controls. Gives loudspeaker results on distant stations.
SUPER PORTABLE	ZENITH RADIO CORP.	$224.00 Complete	None	Tuned radio-frequency	Self-contained loop or antenna	A portable set that includes the loop. Can be operated without opening cover.
SUPER ZENITH Model VII	ZENITH RADIO CORP.	$230.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor or loop	Highly sensitive and selective. Two tuning controls. Gives loudspeaker results on distant stations. Dry or storage battery tubes can be used.
D-14	DEFOREST RADIO CO.	$371.50 Complete	None	Tuned radio-frequency reflexed	Self-contained or external loop	The circuit of this receiver is similar to the D-12 except that five tubes are used, giving the effect of nine tubes through reflexing. The cabinet contains storage "A" battery and dry-cell "B" batteries. Highly selective and sensitive. Gives great volume on local and distant stations.

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Pertaining to Aeronautics

STABILIZER FOR FLYING APPARATUS SUSTAINED BY PROPELLERS.—Intended to solve the problem of the stability and the horizontal mobility of flying apparatus sustained by propellers. Patent 1519866. A. Marchetti, via Fontanella Borghese No. 3, Rome, Italy.

AERONAUTICAL APPARATUS.—Which tends to reduce to a minimum the danger of loss of life, in operating aeronautic devices. Patent 1519622. A. T. Pitman, Danville, Ill.

FLYING MACHINE.—In which the sustaining means consist of oscillating wings which also function as propellers. Patent 1518485. G. W. Cowgill, 1707 Ridge Ave., Evanston, Ill.

Pertaining to Apparel

SAFETY HOLDER.—Providing means for securing various articles, such as letters or miscellaneous papers to the pocket of a garment. Patent 1516035. J. Adamich, 2115 Bush St., San Francisco, Cal.

GARMENT LENGTH GAGE.—Whereby the turning of a hem, when arranged on a form, may be readily gaged. Patent 1519914. M. Jacobs, 104 Pembroke St., Boston, Mass.

VENTILATING DEVICE FOR HATS.—Which may be disposed adjacent to the brim of hats of ordinary construction. Patent 1520290. J. Franklin, 1220 Walnut St., Des Moines, Iowa.

PROTECTIVE GARMENT.—So constructed that large sums of money may be carried with comparative safety against theft. Patent 1520962. H. A. North, 67 Fort Lee Road, Bogota, N. J.

Chemical Processes

METHOD OF GENERATING HYDROCYANIC-ACID GAS.—For fumigating purposes, or the destruction of insects, or undesirable animal life. Patent 1519434. C. S. Banks, 1411 Leveriza Malata, Philippine Islands.

METHOD OF MAKING ARSENICAL SALTS.—Which consists in the oxidation of an arsenite to the arsenate form by electrolysis. Patent 1517516. S. J. Lloyd, c/o A. M. Kennedy, Absolom Power Co., Brown & Marx Bldg., Birmingham, Ala.

Electrical Devices

STORAGE-BATTERY-CELL COVER.—Providing a splash cover and electrolyte gage, and facilities for locking the plates and cover together. Patent 1519867. P. M. Marko, 1402 Atlantic Ave., Brooklyn, N. Y.

OUTLET-BOX CONSTRUCTION.—Which will enable any workman to quickly fasten the box in position flush with a wall or ceiling. Patent 1519927. A. Polhemus, 241 Union St., Jersey City, N. J.

STORAGE BATTERY.—In which the positive and negative electrodes are of serrated formation giving a maximum of electricity storage capacity. Patent 1520587. J. F. McCauley, 1060 St. Clair Ave., Cleveland, Ohio.

ELECTRIC SWIVEL CONNECTION.—Which may be readily attached to an ordinary lighting fixture, and in which the opposite ends have universal movement. Patent 1520308. B. E. Quadri, 1943 Howe St., Chicago, Ill.

FLASH LIGHT.—In which the focusing is accomplished by the actuation of a sliding switch for closing the circuit. Patent 1520,297. H. McKenna, 346 W. 53rd St., Seattle, Wash.

Of Interest to Farmers

THRASHING MACHINE.—Wherein side draft is eliminated, straw tangling in the arms of the beater precluded, and the life of the machine prolonged. Patent 1517481. H. E. Wohlgemuth, Durham, Kansas.

SPADING DEVICE.—In which the rotating spading elements may be shifted laterally to cover a large or small area of ground. Patent 1519465. H. Merrymon, 310 W. Grand St., Carbondale, Ill.

SPRAYING MACHINE.—Constructed for spraying a suitable poisonous liquid upon cotton plants for killing boll weevils. Patent 1519103. J. H. J. Ayscue, c/o Seaside Farms, Mount Pleasant, S. C.

FRUIT HANDLING AND SORTING APPARATUS.—Designed to facilitate the packing and sorting of apples or the like, and adjustable to various conditions. Patent 1520352. A. Johnson, Brewster, Wash.

Of General Interest

FOLDING TABLE—Having a permanent central section, and drop side sections, either or both of which may be elevated. Patent 1513150. A. E. Beaudett, 925 No. 5th St., Albuquerque, N. M.

MOLD—For bricks, comprising separable side and end members, and partitions, and novel locking elements. Patent 1512905. F. P. Bunker, North Manchester, Ind.

THERMOSTAT—Which functions to operate a fire alarm when the circuit is opened under the influence of heat. Patent 1513,517. G. H. Peifer, c/o Anthracite Motor Sales Co., Hazleton, Pa.

GARMENT HANGER—Formed from one piece of wire, a complete suit may be carried by the one hanger. Patent 1514483. Anna M. Thompson, 506 Fort Washington Ave., New York, N. Y.

MANTLE AND WINDOW ASSEMBLAGE—Embodying at the inner side a mantle and above it a window, adapted to be emplaced as a unitary structure. Patent 1514465. S. Sanderson, 88 Woerd Ave., Waltham, Mass.

DISPENSING DEVICE FOR SHAVING CREAM—Adapted for use in barber shops, and requires a minimum of attention by the person operating it. Patent 1514567. L. R. O'Neill, c/o Mennen Co., Newark, N. J.

HAIR DRIER AND COMBER—In which a large number of air jets or currents are directed through the hair longitudinally from the scalp. Patent 1514495. J. Wirth, 241 E. 79th St., New York, N. Y.

RED-LEAD PAINT—Which may be put up in cans and stored for any length of time without hardening. Patent 1513865. B. Semenza, 215 W. 10th St., New York, N. Y.

MEANS FOR USE IN STACKING CASES—And insuring the circulation of air all around the cases, when stacked in a cool chamber. Patent 1514512. A. J. Fisher, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

ADJUSTABLE DUPLEX QUICK-RELEASE FASTENER—Which not only permits the instantaneous release of a strap but also allows a loosening to the extent desired. Patent 1514462. N. Ritter, 2326 83d St., Brooklyn, N. Y.

CALENDAR ATTACHMENT FOR PENCILS—Normally hidden from view, but by a simple manipulation is exposed for reference. Patent 1514449. A. Egger, 207 Tyler Ave., Ridgway, Pa.

FOUNTAIN SEALING DEVICE—For melting and applying sealing wax to letters, packages or the like, in a uniform manner. Patent 1514473. W. Spies, c/o U. S. Color & Chemical Co., 25 Howard St., New York, N. Y.

CEDAR CHEST—In which means is provided for preventing the escape of the cedar vapors, and precluding the admittance of dust. Patent 1514344. E. Roos, c/o E. Roos Co., Forest Park, Ill.

COLOR-HARMONY CHART—Adapted for use by dealers in paints, painters, interior decorators, and others, for obtaining correct color harmonies. Patent 1515512. J. L. Mitchell, 17 W. 108th St., New York, N. Y.

COMBINED RADIOPHONE AND PHONOGRAPH—In one instrument which makes use of the same horn, either radiophone or phonograph being operable independently. Patent 1514,897. R. G. French, 514 S. Winchester Ave., Chicago, Ill.

CASE FORMING A SHAVING REQUISITE—In the form of a box containing brush, razor, etc., with movable lid adapted to form a supporting table. Patent 1515542. F. Bouquet, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

DIRECTORY BOARD—Of neat structure, with means whereby tenants of an office building may indicate whether or not the office is occupied. Patent 1514688. D. A. Dance, 603 Beldon Ave., Chicago, Ill.

NOVELTY DOLL—Formed from an ordinary so-called wash cloth and a cake of soap. Patent 1513312. Lulu Case, 1633 Posen Ave., Berkeley, Calif.

SINK TRAP—Which can be applied to any standard form of sink, for collecting grease or dirt which would tend to block the pipe. Patent 1515073. A. Savard, 5301 Florence Blvd., Omaha, Neb.

QUICK-RELEASE FASTENER—For a strap or binding device, releasing by a simple pressure or lifting action of the thumb or finger. Patent 1515412. N. Ritter, 2326 83d St., Brooklyn, N. Y.

JAR—Having clamping members which may be swung over the cover into locked position. Patent 1514988. H. H. Ordung, 112 Noble St., Laporte, Ind.

WINDOW WASHER AND CLEANER—In the form of a brush of simple yet durable construction and sufficiently rigid for the operations. Patent 1515275. Mary J. Pringle, 303 Jackson St., R. 5, St. Paul, Minn.

PROTECTING COVERING FOR DRINKING VESSELS—Which may be readily placed over a drinking vessel to protect its contents from insects or other contamination. Patent 1515480. H. Hernandez, P. c/o A. G. de Francon, Natnl. City Bank Bldg., Cleveland, Ohio.

LAMP SHADE—Constructed from semi-flexible material by folding or bending so as to eliminate the necessity of a separate frame structure. Patent 1516393. D. Macomber, 111 E. 10th St., New York, N. Y.

FASTENING DEVICE—Designed for securing a chain to an object, or links to each other, without danger of accidental displacement. Patent 1516363. C. N. Watson, 424 No. 17th St., St. Joseph, Mo.

CLOTHES LINE SUPPORT—Of the type in which a pulley-carrying arm is adapted to be swingably mounted. Patent 1516390. K. Ljostad and O. S. Johansen, 71 First St., Brooklyn, N. Y.

HEEL FOR SHOE—So formed that a worn tread lift may readily be replaced without the services of a shoemaker. Patent 1516,384. R. R. Kamada, 140 W. 58th St., New York, N. Y.

FOOD DISPLAY CABINET—Which will not only comply with the usual sanitary laws, but may be easily operated by patrons. Patent 1516404. R. T. Palmenberg, c/o J. R. Palmenberg & Sons, 63 W. 36th St., New York, N. Y.

FIRE ALARM—Adapted for awakening sleeping persons, by an explosive ignited in the event of fire. Patent 1515936. C. De Roos, 2615 So. Class St., Sioux City, Iowa.

GARMENT HANGER—Constructed in such manner that it is supported from its ends, adapted for use in wardrobe trunks or closets. Patent 1517219. C. L. Miller, 18 Bridge St., Brooklyn, N. Y.

HOSE COUPLING—For a gas outlet nozzle, whereby in the event of accidental disconnection, the gas will be automatically turned off. Patent 1517224. J. J. Walsh, 107 South 8th St., Brooklyn, N. Y.

CANDLE SNUFFER—Which can be positioned at any point on the candle, automatically extinguishing the same when burned to that point. Patent 1517115. O. Handler, 1699 Washington Ave., New York, N. Y.

SAMPLING DEVICE—Of such size that it may be carried in a person's pocket, for use in connection with comparing seeds. Patent 1516896. E. B. Turner, Bird City, Kan.

GYMNASIUM APPARATUS—Attachable to the head of the user for the development of the neck muscles. Patent 1517147. A. E. Burnett, 422 State St., Brooklyn, N. Y.

MEANS FOR INTERMENT—Whereby a body may be transferred from an ornamental casket to an imperishable ceramic casket, without violating the religious forms. Patent 1516551. J. H. Stevenson, 203 Corn Belt Bank Bldg., Bloomington, Ill.

FOLDING TABLE.—Formed of hinged sections, with hinged legs, when folded affording storage space for a wall-paper hangers' tools. Patent 1518005. M. Serfaustni, 9 Rue des Boulangers, Paris, France.

WIPER FOR PHONOGRAPH-RECORD-CLEANING ATTACHMENT.—Consisting of various forms, embodying different constructions, with the underlying principle of a soft fabric. Patent 1517864. J. Runk, 225 So. Main St., Stillwater, Minn.

CASTING.—In which the sand core is filled with water from the top, whereby a uniform and thorough chill of the sleeve is effected. Patent 1517675. W. R. Hartung, Box 785, Connell, Wash.

TWIN-COMPACT VANITY CASE.—Whereby upon opening the case both compacts may be conveniently exposed at the same time. Patent 1518071. S. A. Jaroslawski-Fioret, care Fioret Co., 677 5th Ave., New York, N. Y.

FISHHOOK.—Having a plurality of hook members normally grouped together, but released and expanded by the fish taking the bait. Patent 1518052. J. De Paye, Sayville, L. I., N. Y.

FINDER.—For association with a camera, and by means of which photographs of tall buildings may be taken without the object appearing tilted. Patent 1518032. F. A. Wenman, 478 4th Ave., Brooklyn, N. Y.

COMBINED SHIPPING, DISPLAY AND ADVERTISING CASE.—In which the contents can be readily observed through a transparent front, which is protected for shipment. Patent 1518003. J. S. Scott, c/o R. P. Barnes, Sterns Bldg., Albuquerque, New Mexico.

STANDING SUPPORT FOR PICTURES AND THE LIKE.—Which affords facilities for supporting an object, for instance a photograph, and for holding one or more flowers. Patent 1518207. W. P. McCauley, 226 Main St., Kalispell, Mont.

CIGAR-BOX ATTACHMENT.—Providing means for effectually displaying the contents of the box in a window or show case. Patent 1519051. A. W. Rayner, 1829 Wallace Ave., Van Nest, Bronx, N. Y.

VANITY CASE.—In which cosmetics are arranged in one section and cigarettes in another, so positioned as not to interfere. Patent 1519021. C. H. De Bernardi, 468 Summit Ave., West Hoboken, N. J.

LADDER ATTACHMENT.—For supporting and spacing ladder from a wall or building, and operable from the ground. Patent 1519,025. A. M. Fairfield, St. Marys, Kans.

CIGARETTE-PACKAGE FILLER.—Which serves to subdivide the package into compartments and protect each row of cigarettes. Patent 1519000. Edith G. Moore and Margery P. Wood, c/o Mrs. Margery Wood, 550 Park Ave., New York, N. Y.

WINDOW.—Constructed to effectively prevent the ingress of air and dust into a room when the sashes are closed. Patent 1519087. J. Polachek, J. Jespen, and E. Peremi, c/o Polachek Bronze & Iron Co., 476 Hancock St., Long Island City, N. Y.

CARBOY.—Of great strength, having a cushioning device at the bottom, and a cover engaging the carboy. Patent 1518987. C. Lefkowitz, c/o Hercules Carboy & Box Co., 350 South St., Newark, N. J.

APPARATUS FOR TRANSFORMING LIQUIDS INTO A MIST.—By violently projecting the same through nozzles, and producing a vibratory and whirling field. Patent 1519027. E. Garda, 68 Rue Reaumur, Paris, France.

CHECK HOLDER AND PUNCH.—Adapted to carry a pad of checks secured to a belt or the like, and also punch the checks when desired. Patent 1518458. F. W. Schooley, R. 209, 501 Plymouth Court, Chicago, Ill.

REFRIGERATOR.—In which the objection known as sweating is obviated, and in which a circulation of air is maintained. Patent 1518542. J. Nemec, 1700 Wentworth Ave., Chicago, Ill.

BOOK COVER.—Having interlocking features without the use of adhesive or similar

fastening means. Patent 1519948. W. Zuckerman, 2065 Belmont Ave., New York, N. Y.

PROJECTILE—Which may be used in connection with smooth bore firearms in place of the customary shot pellets. Patent 1518,920. J. J. Halloran, 212 Woodrow St., Daly City, Calif.

WASHBENCH.—Adapted to support articles such as wash tubs, but may be folded into small compass for storage. Patent 1519581. M. A. Gorden, 514 Quince St., Brainerd, Minn.

POSTER.—Having means for attaching material to simulate a clad figure. Patent 1519934. C. T. Ross, 43 W. 48th St., New York, N. Y.

PIPE TAMPER.—In the form of pipe attachment for packing tobacco into the bowl of a pipe. Patent 1519955. M. Ciulla and D. P. Fontana, c/o D. Fontana, 374 W. 19th St., New York, N. Y.

CAN SPOUT—With means for puncturing a can, and seating the spout tightly to prevent leakage. Patent 1519911. R. V. Graham, 4547 Park Ave., New York, N. Y.

CHROMOSCOPE. — For use in connection with three-color printing, for observing the effect of altering the colors. Patent 1519919. A. B. Klein, 32 The Pryors, East Heath Rd., Hampstead, London, N. W. 3, England.

PROCESS OF PRODUCING A FOOD PRODUCT.—Which may be used as a substitute for licorice in candies or as an artificial coffee, or beverage. Patent 1519789. E. J. Mocklar, Kalaheo, Kauai, Hawaii.

REFRIGERATOR.—Having means for surrounding the food retaining compartment with the cold water from the ice. Patent 1519441. P. M. Davis, 1014 Ely Road, Winnetka, Ill.

VALVE.—Provided with an attachment for preventing leakage, without the usual fibrous packing. Patent 1519446. C. S. Flowers, 2073 Cottage Grove Ave., Chicago, Ill.

TOOTHBRUSH CONSTRUCTION.—Having disposed in the handle a tooth pick, which will not interfere with the ordinary use of the brush. Patent 1519515. C. A. Stonehill, Glencoe, Ill.

SHOOTING JACKET.—For use in conjunction with a rifle sling, and for absorbing the recoil of the gun. Patent 1519123. A. M. Edwards, 2429 Dana St., Berkeley, Calif.

WEATHER STRIP.—For sealing the edges of doors or other swinging closures, against the entrance of the elements. Patent 1520584. A. A. Lundeen, 5B Calvin St., Lynbrook, N. Y.

DOOR HOLDER.—Arranged for supporting swinging doors in open position, yet readily releasable for closed movement. Patent 1520639. G. A. Garlow, 173 Marshall St., Conneaut, Ohio.

EGG CARRIER.—Wherein groups of cartons may be inserted and removed independently, and resiliently supported. Patent 1520622. E. P. Watson, Sr., Bentonville, Ark.

MOTION PICTURE DEVICE.—For successively visualizing pictorial representations of figures to simulate movement of the same. Patent 1520566. J. W. Doran, 1390 Park Place, Brooklyn, N. Y.

FISHING TILT.—Comprising a line support and signal member, adapted for use in fishing through a hole in the ice. Patent 1520556. H. E. Beckwith, R. F. D. No. 6, Norwich, Conn.

BURETTE.—For use in laboratories, constructed to protect the fluids and chemicals contained therein from oxidation and dust. Patent 1520637. J. P. Frank, 677 High St., Newark, N. J.

SYRUP PAN.—So formed that a stile pan section is provided from which the scum may be conveniently removed. Patent 1520582. E. A. Lester, Mt. Hibron, Ala.

FINGER RING AND METHOD OF FORMING THE SAME.—From a single piece of material, the ends of which are secured to form a gem setting. Patent 1520462. H. Breslavsky, 64 Fulton St., New York, N. Y.

DOOR.—Which is automatically operable, and counterbalanced, especially adapted for use in garages. Patent 1520177. F. B. Dickason, 1421 Logan St., Shreveport, La.

SWIMMING DEVICE.—For supporting the body of a user on the surface of the water. Patent 1520391. C. S. Altoonian, 121 Charles St., Providence, R. I.

CAMERA.—Adapted for use in the process engraving and other copying work under constant uniform artificial light. Patent 1520185. C. G. Johnson, Eau Claire, Wis.

SIGNALING SIREN.—Having means for respectively creating and eliminating sound, to produce rapidly succeeding blasts. Patent 1520225. A. B. Cosgrave and W. H. Lewis, Cosgrave & Lewis, 207 Park St., Montclair, N. J.

IMPLEMENT FOR CLEANING TEETH.—Whereby the teeth may be polished by a suitable material, such as absorbent cotton rolled. Patent 1521425. T. A. Buckley, 2609 Crestmore Place, Los Angeles, Calif.

WATCH CASE.—In which it is unnecessary to solder any of the parts thus effecting a considerable saving of labor and material. Patent 1521456. L. Lubin, 168 Miller Ave., Brooklyn, N. Y.

COLLAPSIBLE TUBE.—On which the closure cap is so mounted as to preclude the possibility of its loss. Patent 1521546. D. K. Kuskin, 2350 Creston Ave., New York, N. Y.

CAISSON AND METHOD OF MAKING THE SAME.—Which affords effectual resistance to downward movement by reason of fins integrally formed thereon. Patent 1521522. C. E. Fowler, 25 Church St., New York, N. Y.

HAIR WAVER.—In which the electric heating elements are incorporated in the backs of the combs forming the waver. Patent 1521529. E. Hagemeister, 126 W. 66th St., New York, N. Y.

TOWEL HANGER. — Comprising spring-pressed jaws, separated by the pressure of the finger in the placing of the towel. Patent 1521472. F. Philippe, Sr., Box 3, South Charleston, W. Va.

WINDOW PORCH.—Which is collapsible and capable of being readily supported from a window sill to afford an enclosure exteriorly. Patent 1521554. A. Guenther, 35 Broad St., Stapleton, S. I., N. Y.

SHIPPING CASE.—Capable of being disassembled for storage, or returned in a knocked down compact form. Patent 1521,512. D. F. Ebbert, Main and 4th St., Wheeling, W. Va.

BRACING APPARATUS FOR FIREPROOF TANKS.—And large liquid containers, so as to prevent their distortion. Patent 1521555. W. S. Huff, 2113 W. Maple St., Stock Yard Station, Oklahoma City, Okla.

Hardware and Tools

HINGE.—Allowing the door to be raised while being opened, and to fall to its original position during the closing action. Patent 1516330. C. S. Butterfield, 1447 O'Farrell St., San Francisco, Calif.

BOX STRAP SEAL.—Readily applied to the overlapped ends of metal straps for locking the same. Patent 1517515. F. L. McGary, Hardinsburg, Ky.

DISPENSING FAUCET.—Intended for use in connection with soda fountains for causing the syrup to be mixed with the carbonated water. Patent 1515768. W. N. Damon, 645 Battery St., San Francisco, Calif.

ATTACHMENT FOR HOT-AIR REGISTERS.—Which will prevent smoke and dust from marring walls adjacent the register. Patent 1518023. I. B. Ullom, Washington, Pa.

SEXTANT REST.—Wherein a freely rotatable member acts as a support, and engages the face of the observer during observations. Patent 1518985. F. W. Kretschmer, c/o Miss McCann, 96 Pioneer St., Brooklyn, N. Y.

FAUCET.—So constructed that washers and the like for maintaining leak-tight joints are dispensed with. Patent 1518367. S. H. Speyer, 95 Nassau St., New York, N. Y.

LOCK WASHER.—Which can be slipped over the end of any standard type of bolt, to lock a nut on the bolt. Patent 1519066. S. B. Smith, 2210 Church Ave., Brooklyn, N. Y.

SCRIBER GAUGE.—The points of which may be simultaneously adjusted in relation to each other and their working faces. Patent 1518647. D. W. L. Frank, 6 Kilmarnoch St., Mobile, Ala.

SAW SET.—Adapted for setting the teeth either by screw or hammer pressure, adjustable to various sizes of teeth. Patent 1519450. C. A. Hanson, Box 111, Wauna, Oregon.

DRILLING DEVICE.—Having means whereby the strain on the drilling cable is reduced to a minimum when lifting the drill bit. Patent 1519512. G. W. Schrock, 2006 16th St., Racine, Wis.

WIRE SPLICER AND STRETCHER. — For stretching a wire, or holding the same during the connection of two ends. Patent 1519982. E. Pasdera, R. D. No. 2, St. Paul, Neb.

LOCK.—With sliding latch, operable only when certain mechanism is properly positioned. Patent 1519933. D. W. Rohrer, 230 South Cook Ave., Trenton, N. J.

SAW GUIDE.—For cutting miters at any desired angle, as for example, cutting rafters or the like. Patent 1520615. J. H. Thompson, New Vienna, Ohio.

SANDPAPER HOLDER.—Whereby one or more layers of sandpaper may be quickly mounted on, or removed from the device. Patent 1520642. G. A. Giroux, 2014 Columbus St., New Orleans, La.

PRINTER'S LOCK-UP SQUARE.—Which may be used in conjunction with a chase having no scale markings thereon. Patent 1521516. A. C. Evans, 331 W. Gold St., Butte, Mont.

ELECTROMAGNETIC TOOL.—For picking up and recovering articles of magnetic material lodged in inconvenient places. Patent 1521,173. R. W. Catching, c/o Motor Car Repairing Co., E. Oak St., Roseburg, Oregon.

Heating and Lighting

OIL BURNER.—Permitting perfect combustion, eliminating carbon, and producing a maximum of heat from a minimum of fuel. Patent 1516903. O. Andersen, 4956 Nelson St., Chicago, Ill.

BURNER.—In which gas is properly fed through all the spaces of a grid, so constructed that it may be readily cleaned. Patent 1519056. F. V. Risinger, 1590 Wagar Ave., Lakewood, Ohio.

OIL BURNER.—For the vaporizing of the oil in the production of a combustible mixture of air and oil. Patent 1519940. J. J. Smith, 368 Houghton St., No. Adams, Mass.

Machines and Mechanical Devices

DRIVE MECHANISM — For sewing and other machines adapted to be operated by foot power. Patent 1514550. O. Londberg, Skanee, Mich.

MIXER—For mixing fibers of different characters, such, for example, as cotton and wool, or fibers of different colors. Patent 1514484. C. C. Truslow, Draper, N. C.

COMBINED WASHING MACHINE AND PRESERVING APPARATUS—Operable to effect a thorough washing of clothes, or readily converted into a fruit or similar food preserver. Patent 1515003. I. G. Watson, 414 S. Main St., Anderson, S. C.

DRAW WORKS—For rotary well drilling, in which the wear on the parts is reduced to a minimum. Patent 1514649. H. C. Brewster, Box 1095, Shreveport, La.

DISPENSING MECHANISM—Wherein peanuts, popcorn, crackers or similar articles may be dispensed in a convenient and sanitary manner. Patent 1514679. J. W. Sigge, 726 Tower Ave., Superior, Wis.

WELL STOPPER—Adapted to be lowered into a well bore and releasably held against movement. Patent 1514978. G. H. McLean, Box 652, Tampico, Mexico.

APPARATUS FOR STAMPING OR BRANDING NUTS—Which automatically stamps a trademark on walnuts or other nuts and delivers them from the mechanism after the stamping. Patent 1515561. R. R. Eastin, Alaska Bldg., Seattle, Wash.

SNOW REMOVER—For melting the snow at the base of a heap preparatory to loading the heap on the remover. Patent 1515553. W. P. Cummings, 25 18th Ave., Long Island City, N. Y.

COMBINATION PUMP, AIR COMPRESSOR AND VACUUM PUMP—In which liquid is caused to circulate by centrifugal means and in which air is caused to enter into the circulating liquid. Patent 1513320. H. Horn, San Francisco, Calif.

WINDMILL—With means for regulating the speed of the mill irrespective of the velocity of the air. Patent 1515817. H. K. Somers, R. No. 1, Champaign, Ill.

STOP MOTION FOR SPINNING MULES—Wherein the parts are so arranged that they may be set to automatically stop the mechanism at any time. Patent 1516354. J. D. Sullivan, 1 Front St., Maynard, Mass.

AUTOMATIC CONTROL—By means of which a single operator can supervise a battery of sugar treating machines. Patent 1516402. C. T. Ordway, 363 Linden Ave., Brooklyn, N. Y.

PROCESS OF AND APPARATUS FOR REFINING CRUDE OILS—By pumping the oil under pressure through heated tubes, and causing the oil to whirl about an axis as it travels. Patent 1516285. C. L. Freeland, Bristow, Oklahoma.

SCALE CONSTRUCTION—Which provides an improved beam and operating member for scales of the dial-and-pointer type. Patent 1516405. F. Plaas, 213 3d Ave., New York.

GRADER AND SORTER FOR NUTS—Which automatically segregates pecan, or other nuts, into established grades, particularly adapted for the use of small growers. Patent 1515757. P. H. Rylander, Box 852, Austin, Texas.

CLUTCH WINCH HEAD—So constituted as to effect a saving of time and labor, and reduces to a minimum wear on the rope and drum. Patent 1515779. G. F. Le Bus, c/o Le Bus Rotary Tool Co., Electra, Texas.

METHOD OF AND APPARATUS FOR AUTOMATICALLY STOPPING AUTOMATIC PRESSES—Providing means for normally holding the lever of a press in operative position until a strain beyond a predetermined limit is imposed. Patent 1515774. L. L. Jones, 66 W. Clay St., Seattle, Wash.

HEDDLE—Formed of superimposed members which are notched to present guiding eyes for the thread without the use of a needle. Patent 1517129. H. Ruegg, 12 Kingswood Ave., Weehawken, N. J.

BY-PASS PREVENTER AND AUTOMATIC SHUT-OFF—Which will automatically operate to shut off the gas whenever the gas meter is removed. Patent 1516889. M. Nauds and H. S. Ross, 1867 2d Ave., New York, N. Y.

CREAM TESTING TANK—Having means for raising and maintaining cream at different temperatures, according to the test desired. Patent 1517194. B. D. Clement, c/o Baker Hotel, Woodward, Okla.

WINDMOTOR.—In which a series of sail-driven trucks travel over a continuous track, and serve to drive a power wheel. Patent 1518022. W. R. Twiford, Box 1, Miami, Fla.

STOKER.—Which automatically maintains the grate clean and free from clinkers, and progressively advances fuel to the furnace. Patent 1518024. M. B. Urquhart, Ideal Bldg., Denver, Colo.

STITCHER-WHEEL DRIVE. — For knitting machines of the circular type, whereby the stitcher wheel will be driven through a train of gearing. Patent 1518046. J. Bloom, 4014 Park Ave., New York, N. Y.

OIL CUP.—Which may be used on crank pins, and other rapidly moving members, without wasting the oil. Patent 1518055. L. C. Dutro, 2020 Cerritos Ave., Long Beach, Cal.

STRETCHER FOR CASE SKINS.—In which the supporting base is secured beneath the table, and the stretcher elements overtie the table. Patent 1518059. S. Friedman, 48 Lafayette Ave., Evergreen, Brooklyn, N. Y.

WINDMILL GEARING.—With transmitting mechanism having simple means whereby to convert a rotary into a reciprocatory motion. Patent 1518016. J. F. Strube, 225 E. "B" St., Hutchinson, Kans.

PAPER-RULING MACHINE.—Having means for preventing ruled paper from adhering to and following the return side of the upper cloth. Patent 1517739. J. Lotz, 360 W. 30th St., New York, N. Y.

TELESCOPIC AIR VALVE AND OPERATING MEANS THEREFORE.—Adapted for use in oil wells, whereby oil may be pumped at any level without lifting the tubing off the bottom. Patent 1517611. A. Boynton, City National Bank Bldg., San Antonio, Texas.

ATTACHMENT FOR BEATING ENGINES.—For increasing their efficiency, the device is adapted for use with beater rolls of various lengths. Patent 1517783. J. L. Harris, Thomson, N. Y.

TENSIONING DEVICE FOR SEWING MACHINES.—Whereby the thread can be subjected to any given tension and registered at sight. Patent 1518494. R. Elcock, Victoria Mansions, Eloff St., Johannesburg, Transvaal, South Africa.

WEIGHING SCALE.—Which dispenses with the use of springs and weights, yet is accurate in its indications. Patent 1518982. E. Harrold, Leetonia, Ohio.

STONE-SETTING DEVICE.—Adapted to the jewelers' art, for securing precious stones and the like in the settings of rings. Patent 1519040. I. T. Nedland, Hillsboro, N. D.

DEVICE FOR FORMING EYES ON METAL STRIPS.—Which will readily grip one end of a metal strip and bend the same to form an eye. Patent 1518654. G. N. Hammond, 435 E. 2nd St., Pomona, Calif.

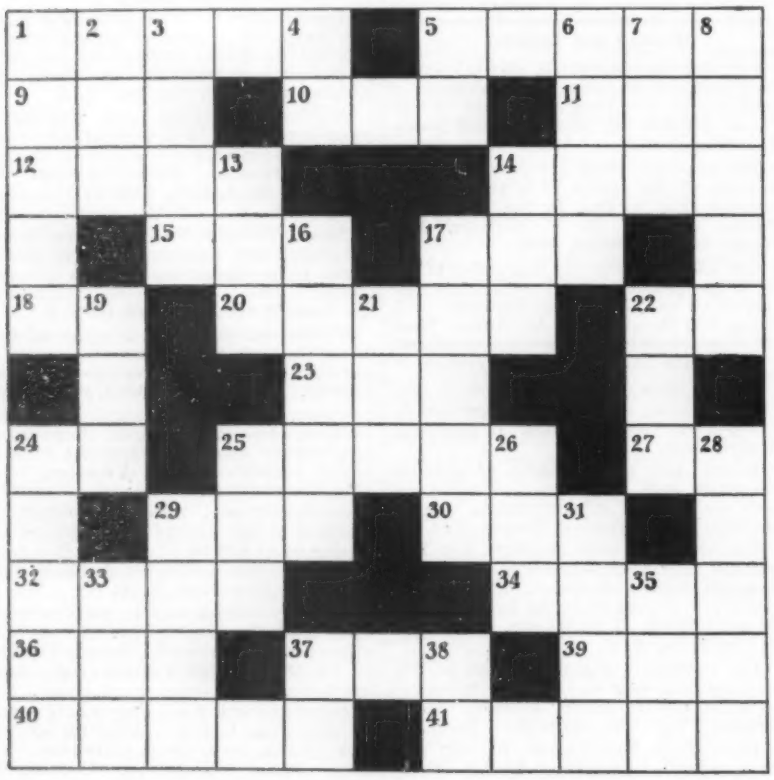
A Cross-Word Puzzle

Test Your Knowledge of Scientific Terms. Earn a Credit Toward a New Subscription

By Jack Barrett

LIKE everybody else, the Scientific American has succumbed to the cross-word puzzle craze. All the words in the puzzle printed on this page are technical, industrial or scientific terms or are words frequently used in technical writing. *All these words are contained on pages 190 to 216 of this issue of the Scientific American.* Some of the words will be found in the text, some of them in the advertisements.

If you can solve the puzzle and can find the place of each of the words in this issue, by page, column and line, we will give you a credit slip of one dollar toward a new subscription for the Scientific American. By a little mental exercise you can give a friend the useful present of a year's subscription to our magazine at a cost (in the United States) of only three dollars. All the conditions are explained below.



How to Solve the Puzzle

THE numbers in the squares refer to the definitions. Thus: 1 Horizontal calls for a word that will answer the definition and at the same time fit into the number of white squares running horizontally from Number 1 to the first black square to its right. 1 Vertical applies in the same way except that the right word must fit into the number of squares from Number 1 downward to the first black square. When all the correct words have been inserted the words will interlock and the puzzle is solved. In starting to solve the puzzle, go through the definitions and fill in all the words you are sure of first. You will find that the letters thus provided will give you keys to the more difficult words. Whenever you insert the letters in the squares of a vertical word it is a good plan to check that word with a horizontal word crossing it, and vice-versa.

How to Get Your One Dollar Credit Memorandum

THE definitions printed on this page give you the keys to the puzzle. When you have identified each word, look through the pages of this issue, between page 190 and page 216 inclusive, until you find that word. Then set down the page, column and line on which you found the word, in the blanks provided for that purpose. Clip out this whole half-page; puzzle, filled-out blanks and all; and send it to us. If your solution is correct and if all the words are properly placed, according to page, column and line, we will send you immediately a credit memorandum good for one dollar toward a new subscription to the Scientific American. This subscription may be in the name of anyone you like. Only one credit memorandum is good on each subscription. The $3.00 balance ($4.00 for foreign subscriptions) must be paid in cash or by check.

Some of the correct words may occur at more than one place on pages 190 to 216. This makes no difference. A reference to one place for each word is sufficient, provided that reference is correct. Each word must be found on pages 190 to 216 of this issue, inclusive. No other page will do.

If you fail to solve the puzzle and want to know the solution you do not need to wait for our next issue. Send us the best you can do toward the solution and we will mail you the full and correct one immediately.

It is not necessary to clip this page unless you wish. Your solution may be sent us on a sheet of paper. But be sure to give *every-one* of the words and the *exact place* where you found *each one* in the specified pages of this issue.

To be considered for credit solutions of this puzzle must be mailed to us before midnight of March 19, 1925. A new issue of the Scientific American will appear on March 20 and will carry another cross-word puzzle on which you can test your wits during April.

Address: Cross-Word Editor
Scientific American
Woolworth Building
New York, N. Y.

Insert in the blanks below the places on pages 190 to 216 of this issue where you found the correct words of the puzzle. No other pages will do. The exact position must be given for each word.

Definition (Use these definitions in solving the puzzle)	*Page* (the number printed on the page)	*Column* (1, 2, 3 or 4, counting from left to right)	*Line* (by number, counting downward from the top)
HORIZONTAL:			
1. An implement used in digging.			
5. Part of the driving gear of an auto (plural).			
9. A small metal tag.			
10. The state of matter most capable of compression.			
11. A natural compound containing metals.			
12. Tools for piercing holes.			
14. The first step toward getting a patent.			
15. Conjunction meaning nevertheless.			
17. A single unit.			
18. An abbreviation for one older in years.			
20. The torso of the human body.			
22. Latin word for bone.			
23. An ancient beast of burden.			
24. Abbreviation for a unit of weight.			
25. A loosely woven textile material.			
27. Abbreviation for a New England state.			
29. To be afflicted.			
30. Outlet from parts of a radio coil.			
32. One of a pair.			
34. An insect whose larvæ feed on wool.			
36. Possessed.			
37. An auto to carry many people.			
39. One side of a boat at sea.			
40. To try or attempt.			
41. To cut off by a sidewise stress.			
VERTICAL:			
1. Heavenly bodies composed of hot gases.			
2. The pedal extremity of the family *Felis*.			
3. To do something in a capable manner.			
4. For example (abbreviation).			
5. A conjunction used in comparisons.			
6. Mineral in place in the earth.			
7. Before.			
8. Closes tightly with molten matter.			
13. Something that cement does.			
14. A fluid used in writing.			
16. A method of fishing.			
17. Beginning.			
19. Part of an umbrella.			
21. To employ.			
22. A unit of electrical resistance.			
24. A machine tool.			
25. A metal whose compounds are used to weight silk			
26. Engineering work to develop power.			
28. The thing that carries light.			
29. Things that help you.			
31. A device used on overhead trolleys for street cars.			
33. Part of the verb "to be."			
35. One of the plants from which caffein is obtained.			
37. Preposition indicating agency.			
38. Abbreviation for an ocean liner.			

¶ *Our next issue will contain another cross-word puzzle. Unless you are a regular subscriber better ask your newsdealer to reserve a copy of the April issue (out March 20th) for you.*

Music

Far away in a spacious hall, a great orchestra unrolls the rich melody-pattern of a master symphony. Far away in a vast cathedral, an organ pours forth the theme of an age-old hymn. Far away in a world-famed opera house, a drama is revealed in song.

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The telephone shortage is never far away. If for a few years the telephone company was unable to build ahead, if it neglected to push into the markets for capital and materials for the future's need, there would be a recurrence of the dearth of telephones. No one could dread that eventuality so much as the 350,000 telephone workers.

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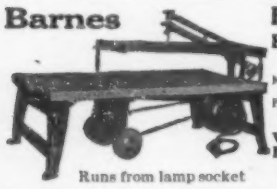
Barnes



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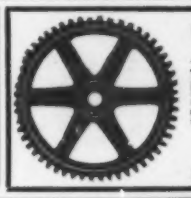

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The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear elsewhere in this issue

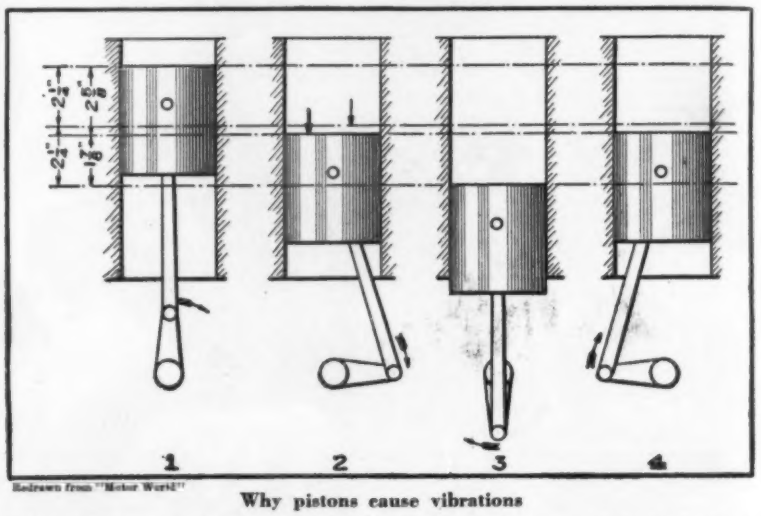
Conducted by Albert G. Ingalls

Killing Vibrations with Vibrations

A LARGE part of the vibration which has been caused by the rapidly moving pistons of the motor-car engine has been done away with through the adoption for the first time on any American car of a device called the Lanchester balancer. This simple device operates on the easily-understood principle of creating special vibrations of its own, each individual vibration being so accurately gaged for strength and so exactly timed that it meets one of the vibrations caused by the rapidly moving pistons and destroys it. At the same time, of course, it is itself destroyed.

when two of the pistons of a four-cylinder motor are going down, two others are coming up; and they ought to balance each other exactly. So why worry?"

They would balance one another exactly but for a fact that most people overlook. It is only natural to think that each piston starts from rest at the top, reaches its highest velocity *half way down* the cylinder, and comes to rest again at the bottom of its stroke. Yet this is not the case. The point of highest piston velocity is not half way down the cylinder, but a little bit more than half way down. Similarly, on the return or up stroke, the point



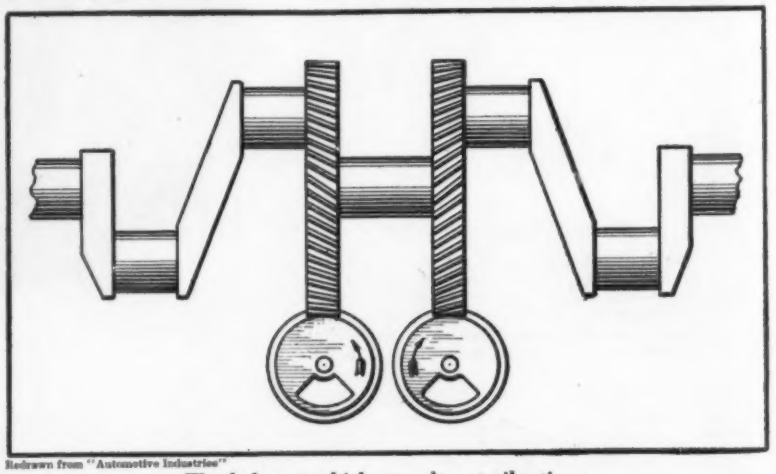
Redrawn from "Motor World"

Why pistons cause vibrations

This principle is well illustrated by an experiment the reader can easily try where he sits. Move your fist rapidly up, down, up, down, as if you were pounding an imaginary table. Note how it wrenches and shakes your body and even your chair. Your fist is an unbalanced piston.

of highest velocity is a little lower than half way up. At first these facts generally strike people either as doubtful or unaccountable, even if true.

Referring to the first of the two accompanying cuts, position 2, you will see that when the crank pin is half way down, the connecting



Redrawn from "Automotive Industries"

The balancer which cancels out vibrations

Now, do the same with both fists, keeping one directly over the other but moving them so that when one goes down the other moves up toward it. This time you can hold your body comparatively still. Your fists, moving always in opposite directions, are two exactly balanced pistons. Each fist transmits a vibration to your body, but the forces are equal and opposite, and thus they cancel each other out.

Now, if you know motor cars you have probably already objected. You have said, "But

rod is forced to take up a diagonal position. This in turn drags the piston down *lower* in the cylinder than it would have to go if the connecting rod were merely reaching to the center of the crankshaft instead of reaching out to one side as well.

To illustrate this, stoop over and touch the floor at your feet with your fingertips. Then, without straightening up, again touch the floor at a point a foot or more in front of you. To do this you had to bend your trunk still lower.

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The piston of the motor corresponds to your trunk, and your arm is the connecting rod. When the connecting rod has to reach a position level with the center of the crankshaft, and to one side *also*, it necessarily drags the piston down about three-eighths of an inch below the middle of the stroke, as measured on the walls of the cylinder.

The consequences are that the piston has to travel *faster* while the crankshaft makes the first quarter turn than it travels during the second quarter turn.

If, therefore, the piston moves faster, then the reaction thump or shock given to the crankshaft due to the checking of this extra velocity will be felt by motor, chassis and finally by the passenger in the form of continual vibration.

There is no use relying here on some other piston to balance the shock out, for the oppositely placed piston is doing just the same thing at the same instant on its up-stroke. Thus it is making things still worse. Here is the opening for the Lanchester balancer.

This single device has been in use on a few high-priced European cars for a number of years, and it has now been built in as a part of the motors of the new Willys-Knight stock cars. What is it like?

If you were to take a cylinder of solid metal, three inches long and three inches in diameter, bore out some of the metal on one side of the axis, thus making it lopsided, and then equip it with horizontal axles and place it on a testing bench and revolve it rapidly, it would set up a terrific vibration. It would act just as an unbalanced flywheel would act.

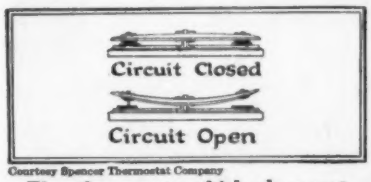
The Lanchester balancer employs two such cylinders placed side by side, geared to the crankshaft and timed so carefully that when the pistons are delivering their vibratory reaction thrusts to the engine, the balancer is throwing equally strong thrusts in the opposite direction.

The result is that the two sets of vibrations cancel each other and the chassis vibration due to the above causes is done away with.—*Motor World* (New York), vol. 80, pages 24-26 (Sept. 4, 1924) enlarges on the theory; while *Automotive Industries* (New York) vol. 5, pages 435-436 (Sept. 4, 1924) shows manner of application to Willys-Knight motor; also see editorial, same issue, page 455.

* * *

The Snapping-bug Thermostat

A NEW type of thermostat which makes instantaneous and positive electric contact instead of gradual and uncertain contact has just been put on the market. The new thermostat is of the disc type.



Courtesy Spencer Thermostat Company

The thermostat which does not hesitate

A thermostat which would fulfill two requirements has long been wanted. It must show no tendency to make contact ere the predetermined temperature was reached; and it must make a sudden, sure and positive contact exactly when the predetermined temperature was reached. The thermostats we have had heretofore were not nearly as positive in this respect as the new one.

The new thermostat works on a principle like that which makes the bottom of an oil can snap in and out. When you press on the bottom of the oil can it resists your pressure until you have pressed hard enough to overcome this resistance. At that point, instead of yielding gradually, it snaps in suddenly.

The common bi-metallic thermostat does not operate in this manner. It is made up of adjacent strips of different metals or of other materials. Since no two materials expand to exactly the same extent when heated, if two materials whose co-efficient of expansion differ quite widely are chosen and are attached to one another throughout their entire length, then when they are heated the one which expands the more will force the one which

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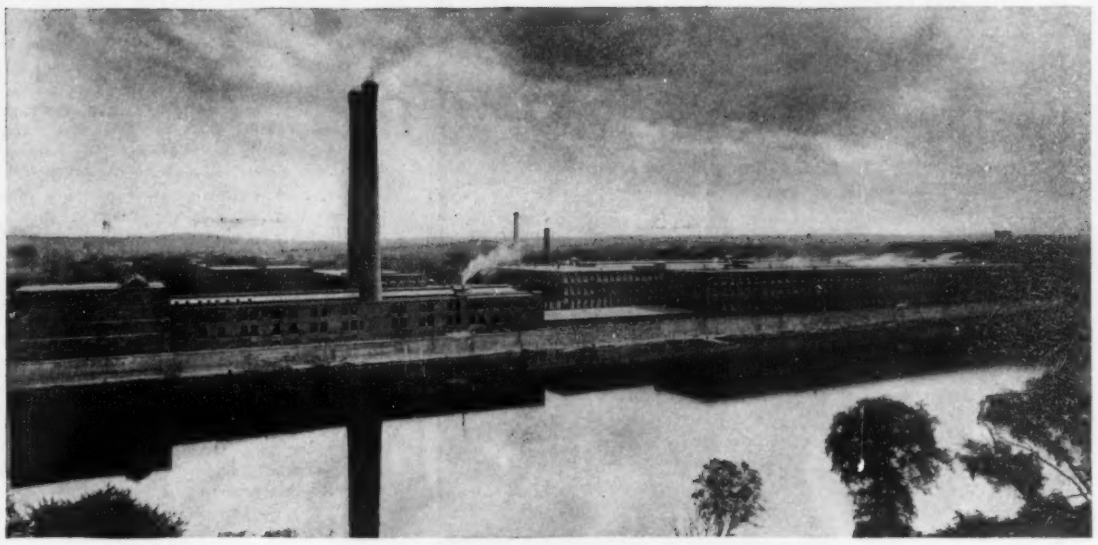

PRINT WORKS DEPARTMENT, THE PACIFIC MILLS CO., SOUTH LAWRENCE, MASS.—*Lockwood, Greene & Co., Engineers*
A modern group of buildings of the "Standard Mill Construction" type

Three Reducible Items of Industrial Overhead

A message to Business Men about Weyerhaeuser-Ideal Industrial Construction

PROBABLY 50% of the industrial construction in 1924 is in position to take advantage of the Weyerhaeuser exhaustive researches into reducible industrial overhead.

Even with unavoidable costs as they are today, it is quite possible to save as much as 15% on capital building cost—thus lowering tax charges also.

Save up to 15% on interest charges.

Save up to 75% on insurance charges.

The manufacturer who can control these three items will come closer to having the competitive situation in his own hands.

AS Weyerhaeuser points out in its study of industrial buildings, the typical industrial building of today adds a good deal more to the overhead of a business than it did prior to about the year 1900.

"Fireproof" has been a word to conjure with.

Yet the man who is planning to build a factory or warehouse today may well ponder the fact that the only successful, sizable concerted effort to reduce fires in American industry was carried out in buildings mainly of the "Mill Construction" type.

In one section of this country there are hundreds of great factories built of "Mill Construction," and protected by sprinkler system against inside fires, in which the losses from fire over a recent 3-year period have averaged only 3½ cents per $100 of insurance written.

IN BRINGING the above factors into the light for the Industrial Man, Weyerhaeuser is aware that it has also assumed a responsibility that "Mill Construction" shall *not* be used when this type of construction is not suited to the purpose of the building.

For this reason, and in extension of its program of service, to American industry, Weyerhaeuser has inaugurated the *personal consultation service* by the Weyerhaeuser Expert Construction Engineer.

In the same spirit of enlightened lumber service, Weyerhaeuser has made a survey of its resources of great sound timbers for Industrial Construction.

The Douglas Fir Mills of the Weyerhaeuser organization are producing selected timbers of the finest possible wood for "Mill Construction" needs.

Through the Weyerhaeuser distributing plants in the heart of Eastern and Mid-Western markets, these timbers are laid down quickly and economically in every industrial section of this country.

RESPONSIBLE members of industrial concerns are invited to send for complimentary copies of the Weyerhaeuser books—"Industrial Buildings," written for the Business Man, and "Structural Timbers of Douglas Fir," a book for the Building Engineer, Architect, and Purchasing Agent.

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SAINT PAUL · MINNESOTA

Producers for industry of pattern and flask lumber, factory grades for remanufacturing, lumber for boxing and crating, structural timbers for industrial building. And each of these items in the species and type of wood best suited for the purpose.

Also producers of Idaho Red Cedar poles for telephone and electric transmission lines.

Weyerhaeuser Forest Products are distributed through the established trade channels by the Weyerhaeuser Sales Company, Spokane, Washington, with branch offices at 208 So. La Salle St., Chicago; 220 Broadway, New York; Lexington Bldg., Baltimore; and 2694 University Ave., St. Paul; and with representatives throughout the country.

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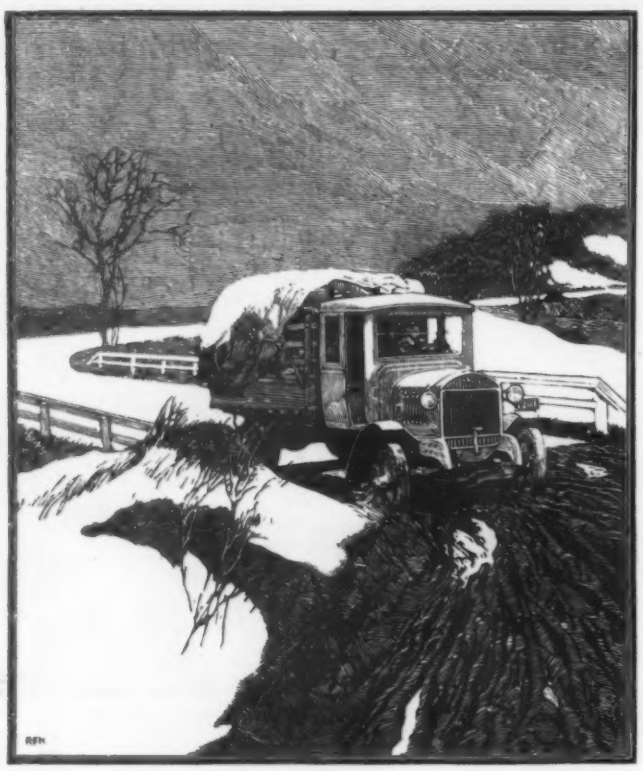

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GENERAL MOTORS' skill, thought and resources have been centered on the development of General Motors Trucks to such high efficiency that G M C's do better work, longer.

¶ This is one reason why, almost invariably, the purchase of the first G M C is followed by the purchase of more.

Besides the more than $500,000,000 which backs the continued advancement of GMC Trucks, General Motors Corporation places behind these trucks exhaustive research in General Motors Research Laboratories. GMC Trucks also share in the vast purchasing power of General Motors. These advantages greatly enhance the value and stamina which every GMC owner finds in his trucks.

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General Motors Trucks

GMC

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expands the less to curve like a bow. This curving action has long been used for the purpose of controlling electrical circuits automatically for thus operating many kinds of apparatus.

Since, however, thermostats of this sort curve or curl practically at a uniform and gradual rate the contact made by them is also formed gradually. This often results in the formation for a time of an electric arc between the contacts. This may make and break the circuit several times before a firm contact is established.

The basic principle of the new disc thermostat which does not have these faults was first noticed in a Maine logging camp. There a wood-stove was equipped with a stove-pipe having a T-joint, one side of which was closed permanently by means of a metal disc. When the fire in the stove was burning well this disc would bulge out. It was noted, however, that as soon as the fire became low the disc would snap in, changing from a bulge to a concave shape. This action, which depended in this case on the purely accidental manner in which the metal disc was first put into the end of the stove-pipe fitting known by tinsmiths as a T, soon came to be regarded as an alarm clock. It meant, "Put more wood on the fire." It also set John A. Spencer of the Spencer Thermostat Company (Cambridge, Mass.) to thinking.

The disc thermostat which finally resulted from Mr. Spencer's efforts snaps and makes firm contact so suddenly and so fast that oscillograph records show a velocity approaching that of a rifle bullet. In fact, the three-inch disc snaps so powerfully that it will drive a tack completely into a board.

Most people associate thermostats with control of household furnaces, but in addition to this they are used to control heat in a large number of special industries.

Courtesy Atlas Lumnite Cement Co.

One-day-old pipe of quick-strength cement holds up twelve-ton load

Concrete That Hardens While You Wait

A CEMENT that sets to full strength within twenty-four hours instead of the twenty-eight days required to develop the full strength of the ordinary portland cement with which most of us are familiar has recently been put on the American market.

Roads constructed of concrete made with this alumina cement (Atlas Lumnite Cement Co., New York, a subsidiary of an older, well-known company), harden so rapidly that instead of having to detour traffic from them during one or two weeks, a fifteen-ton truck, a heavy bus or a ten-ton tractor may be driven over these roads the day after they are laid down without even injuring the surface.

Although cement of this sort is at present being made by only one American manufacturer, its production is a most significant development in the world of engineering. This is because most jobs on which concrete is used are hurry-up jobs. Engineers and others have previously been delayed in completing all sorts of important construction work because of the lack of a hurry-up cement.

Although alumina cement is a new product on the American market, cements of this type are not equally new in Europe. Alumina cements which set within one day were first developed in France under pressure of the World War. On many occasions emplacements for heavy guns were needed in a hurry. To meet this requirement, quick-setting cements were developed. Gun emplacements laid down with the new cement became strong enough within one day to support large-bore guns.

When the war was over Europe continued to make quick-setting alumina cements and to use them. Certain it is that while no such cements of American manufacture were available in this country until very recently, the technical press of the European countries, especially France, has contained frequent mention of quick-setting cements. We now have a cement of this nature which is being manufactured in America.

In Germany an interesting development has followed on the heels of the one just described. The rapid adoption of the alumina type of cements which attain strength in one day has forced competing manufacturers of products such as ordinary portland cement to bring them to a higher degree of setting speed. Thus far, the quickest full-strength set developed in any German portland cement of this nature is about three days.

It is thought that this comparative approximation of the quick-setting qualities of alumina cement attained by common portland cement was brought about by a more careful selection of the ingredients, by grinding them finer, and by burning them more thoroughly. Naturally, this makes the cement cost more money than slow-setting cements cost.

As a result of this German development certain American cement manufacturers are said to be experimenting with considerable success with portland cements of the usual composition and characteristics, except that like the German portland cements just mentioned they will come to full strength within a period of time approaching that required for the alumina cements to reach full strength. No such portland cements are yet on the American market, but the still faster alumina cements are.—*Engineering News-Record* (New York), vol. 93, pages 910-911 (Dec. 4, 1924); also editorials, same magazine, Nov. 27, 1924, page 856; and Dec. 4, 1924, page 896.

* * *

Has Niagara Falls a Future Power Rival?

Is Niagara Falls the greatest potential source of power of all waterfalls? Or are two or three other waterfalls on rivers in the far interior of South America and Africa much greater, as often claimed by space-

writers in the Sunday newspaper supplements?

Howard P. Quick, a consulting engineer of New York City, has made an analysis of four of the great waterfall power possibilities of the world. These are the falls of the Zambesi River in Rhodesia, the Santa Maria or Iguazu Falls of Southern Brazil, the falls of the Parana River on the Brazil-Paraguay boundary and Niagara Falls. He finds, after all, that when it comes to usable power Niagara Falls stands at the top.

Height alone does not tell the story; nor does volumes of water behind the dam. The power that can be obtained from each fall must be found in each case by multiplying the two factors. Incidentally, the matter of volume is open to wide misconstruction, for what is needed is not exceptional volume, but all-the-year-around volume. This, Niagara has to a degree not possessed by any other of the four waterfalls named.

The available power drops of the four falls are as follows: Zambesi Falls, 380 feet; Parana Falls, 361 feet; Niagara Falls, 327 feet; Iguazu Falls, 300 feet. But the volumes vary, so that after making due allowance for the restrictions to be made on the use of power from Niagara Falls on account of the preservation of their scenic beauty, and then considering the other three reduced to the same basis, we should be able to obtain from each of them as follows:

From the Parana Falls, about 2,600,000 horsepower.

From the Zambesi Falls, about 215,000 horsepower.

From the Iguazu Falls, about 183,000 horsepower.

From the Niagara Falls, about 3,300,000 horsepower.

"So, sad to relate," writes Mr. Quick, "compared with the mighty demands that the regions adjacent to these falls may be expected to make for power, our fondest hopes for some of them as power producers must be abandoned. It is evident that two of the above sites must yield their claim to a place with the big four water powers of the world."

"We may venture to predict," he continues, "that the Paulo Affonso Falls on the San Francisco River in eastern Brazil, with its enormous watershed and 260-foot falls; and some falls in the Congo Basin of Africa will take the place, as they become better known, of the Iguazu Falls of southern Brazil and the Victoria Falls of the Zambesi River, South Africa, as contenders for places with the Big-Four waterfall power sources of the world."
—*The Canadian Engineer* (Toronto), vol. 47, pages 189-192 (July 29, 1924).

* * *

Spotting Cast Iron Cheeseholes with X Rays

DANGEROUS, hidden flaws that lurk unsuspected under the smooth misleading surfaces of important iron castings are being spotted nowadays by means of especially developed, powerful X-ray apparatus capable of penetrating metal up to three inches in thickness.

Sometimes heavy metal castings break without warning even after years of service. Accidents result and lives may be lost—all because a little bubble or two of gas remained enclosed within the cooling metal after the casting was poured in the foundry. Even the best castings, made by the most up-to-date methods, often conceal dangerous flaws beneath the surface. If foundrymen knew how to keep them out of the metal they would do so, but we have not yet found any sure way to make flawless castings.

In addition to gas pockets, which make the interior of some castings look like Swiss cheese, there are sometimes cracks which are so minute and narrow that surface examination does not reveal them. Inclusions of foreign matter such as sand may also occur. These weaken the metal of the casting.

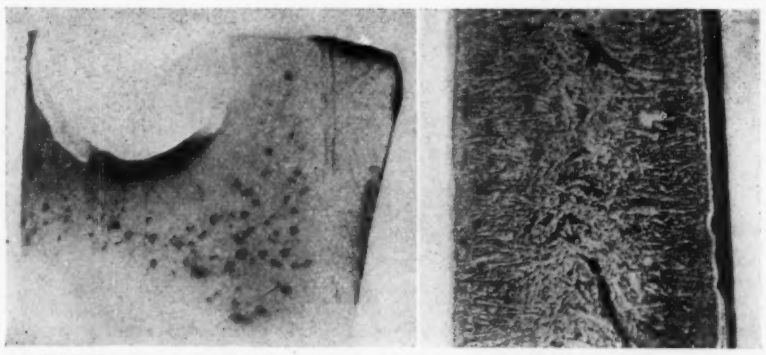
The X-ray method of testing castings has been developed very largely at the Watertown Arsenal (Watertown, Massachusetts). Here, important work and research for the purpose of improving the design and construction of big guns for Uncle Sam's army and navy goes on both in time of peace and in time of war; but other work, bearing on peacetime industrial progress, also occupies much of the time of the government research staff.

Electric pressures of over 200,000 volts are employed to activate the large X-ray tubes necessary to send the tiny vibratory undulations called X rays clear through pieces of metal three inches thick. Even then, a thirty-minute exposure to the X rays is required in order to impress a clear image of the internal structural features of the metal upon an X-ray plate.

When the thickness of the metal is only one inch, however, a single minute is sufficient to produce satisfactory results; while five minutes suffices for two-inch metal.

At the Watertown Arsenal one trial casting is first made from each new wooden pattern. This casting is then X rayed. The interpretation of the film or plate thus produced often suggests changes that should be made in the shape of the pattern in order to eliminate defects which are due to the location of the risers. The risers are the parts of the pattern which it is necessary to add in order to provide a channel in the sand for the molten metal to flow into the cavity that is left when the pattern is extracted.

The cost of making X-ray films of castings in order to study and ferret out the cause of defects that might uniformly affect all of a large group of identical castings is far less than the older method of cutting up castings to ascertain their soundness or lack of soundness.—*American Machinist* (New York), vol. 61, pages 911-912 (Dec. 11, 1924); also *Chemical and Metallurgical Engineering* (New York), vol. 31, Oct. 20, 1924, four pages.



At the left is an example of gas cavities in cast steel as shown by X-ray negative. At the right is a photograph of a section that showed capillary piping

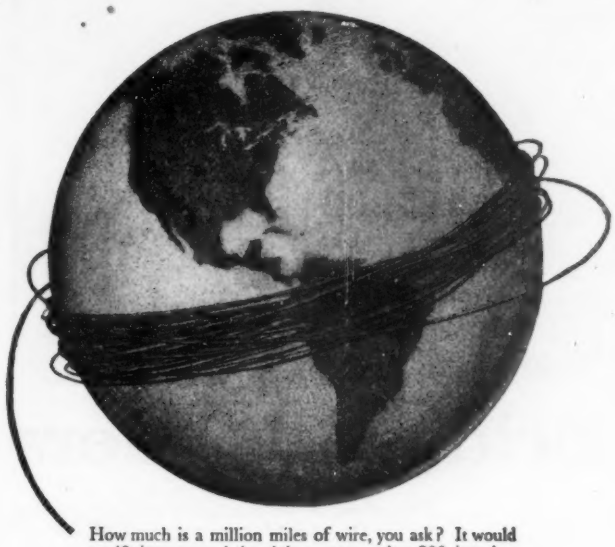
* * *

And Now the Super-Locomotive

A LOCOMOTIVE which generates steam at considerably higher pressure than any locomotive has before, and which goes back to the compound principle which the designers of locomotives practically discarded ten or fifteen years ago, has just been built and put in operation on the Delaware and Hudson Railroad. It is claimed that the power developed by this unique locomotive can be derived from only two-thirds the amount of fuel and water now required by locomotives of equal capacities.

The new locomotive employs a steam pressure of 350 pounds per square inch. The steam is first introduced into the cylinder on the right side of the engine, where it expands. It is then exhausted into a receiver and flows into the cylinder on the left side.

FACTS ABOUT A FAMOUS FAMILY



How much is a million miles of wire, you ask? It would go 40 times around the globe; or more than 300 times between New York and San Francisco.

1,000,000 miles of wire

In a single year General Motors uses over 1,000,000 miles of insulated copper wire in the manufacture of Delco and Remy starting, lighting and ignition systems—standard equipment on more than 30 makes of trustworthy cars and trucks.

Wire is but one of many materials which General Motors buys in quantity. The steel used in a year would lay a railroad track between New York and Denver. The lumber would build homes for 50,000 people. The leather would cover 150 city blocks.

Such large purchases contribute to the prosperity of many businesses and are a real factor in the economical manufacture of General Motors products.

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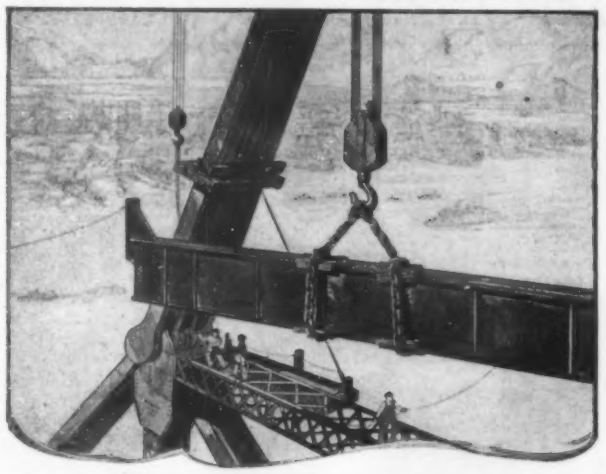

Bridge Builders

Co-workers in the stupendous task of spanning water with steel, are the brawny men and still more brawny cables. Together they fabricate the massive structure and anchor its ends to either shore.

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Yellow Strand is the highest grade rope that this fifty-year-old company knows how to make. They also manufacture all the standard grades, for all purposes, each supreme in its class.

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Carry a Basline Autowline in your car and safeguard your spare tire with Powersteel Autowlock. Both are made of Yellow Strand. Ask your accessory dealer.

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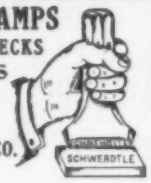

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This is the low-pressure cylinder and is, of course, larger than the right-hand cylinder. From the low-pressure cylinder the steam is exhausted into the stack, as is the case with other locomotives. By these means the steam is more fully utilized before it is thrown out into the air.

In addition to these uncommon features the new engine is equipped with a booster, mounted on the rear truck of the tender. The purpose of the booster is to boost. It boosts when short, steep grades are met, and it boosts when the locomotive must start heavy trains. It is harder to start a train than to keep it in motion. The booster does not work at all times, but only at low speeds. It draws from excess energy generated by the boiler and is meant only for temporary use.

Back of the high steam pressure used in the boiler of this locomotive is an interesting bit of thermodynamics which applies not only to the locomotive, but to the stationary steam plant as well.

The higher you raise the steam pressure, other things being equal and practicable, the higher you increase the power return from the fuel. That is, you would get much *more* than twice the return from steam at say, 200 pounds per square inch, than you would at 100 pounds.

The reason why this is so lies in the very nature of evaporation itself. Starting with water at some temperature above the melting point of ice, experiments show that this water will increase in temperature in proportion as it is supplied with heat.

When it reaches 212 degrees, however, a strange thing happens. It keeps right on absorbing heat, but for a long time it refuses to boil. Water, for example, that has absorbed 180 units of heat in heating from the melting point of ice to the boiling point will absorb 980 units more without being raised in temperature at all. When the 980 units of heat have been absorbed, however, the water bursts into steam. This added heat that seems to produce no results is called the latent heat of evaporation and it is the putting of this latent heat of evaporation into the water that makes the generation of steam so expensive.

Courtesy of the Delaware and Hudson Co.

The new locomotive which uses steam at nearly double the usual pressure

Having at last supplied the water with the necessary heat units and made it burst into steam we now find that the theoretical power possibilities of this steam are in proportion to its pressure and temperature. It requires comparatively little additional heat to put steam under pressure.

Thus, it takes about 1,150 heat units to change water into steam at no pressure. But to go on and raise it to 200 pounds pressure per square inch requires *only* about forty-nine additional heat units.

Suppose, now, that we go still further and raise it to 350 pounds per square inch, thus securing seventy-five percent more power from it, we can get this temperature by adding only a bit over seven units of heat.

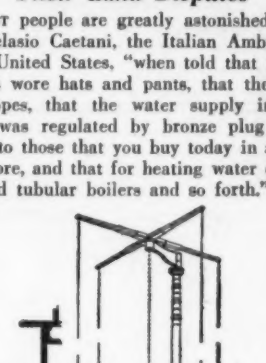
In other words, the expensive part of the steam raising operation comes at the beginning. Once the water is evaporated, the benefits can be reaped with comparative ease, provided we can still keep our benefit-reaping apparatus practical.

To use steam at 350 pounds per square inch requires an especially constructed boiler. In the new locomotive the familiar type of multitubular boiler used on ordinary steam locomotives, in combination with the superheater, is retained; but instead of the usual firebox with its undesirable flat sheets and staybolts that shear, the firebox of the new engine has been built up of self-supporting cylindrical structures. These are in the form of drums and tubes disposed horizontally and vertically. —From statement issued by the *Delaware and Hudson Company* (New York).

* * *

How Pompeiian Neighbors Settled Their Land Disputes

"MOST people are greatly astonished," says Don Gelasio Caetani, the Italian Ambassador to the United States, "when told that the old Romans wore hats and pants, that they used wire ropes, that the water supply in their homes was regulated by bronze plug valves similar to those that you buy today in a hardware store, and that for heating water quickly they had tubular boilers and so forth."



Courtesy of "Engineering and Mining Journal-Press"

Roman surveyor's transit found in Pompeii

Recently the remains of a Roman surveying instrument was laid bare in Pompeii by the spade of the archaeologist. The Italian Ambassador, who is not only a diplomat but a great mining engineer, reports the interesting find to the *Engineering and Mining Journal-Press* (New York, vol. 118, page 855, Nov. 29, 1924).

The Romans called the instrument the groma, and its purpose was to lay off angles on the earth's surface. In other words, it is a surveyor's horizontal circle combined with the quick adjustability of the vertical circle of the modern transit.

The groma shown in the accompanying illustration consisted of an upright pole which could be set up over a stake or monument. It supported four horizontal arms set at right angles to one another. From the end of each arm a line and plumb-bob was suspended.

By back-sighting along one of the two pairs of plumb-lines and then, by sighting along the remaining pair at right angles to the first pair, a fairly accurate right angle could be laid off. The use of plumb-lines for sights had the decided advantage that the contour of the land could be ignored, thus making the groma, in this regard, a transit instrument.

The parts of the groma were found in the workshop of a former Pompeiian mechanic named Verus. Since only the metallic parts remained intact, their interpretation was at first a puzzle. The director of the excavations, Professor Mateo della Corte, finally succeeded in working out the true solution.

The versatile Italian ambassador suggests that engineers and others could easily construct a crude groma should it ever become necessary to lay off a square-cornered plot of land in the absence of better instruments. On a calm day, fairly accurate angles could be thus laid off.

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Snuffing Out a Giant Candle

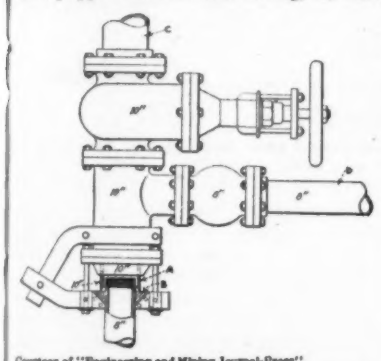
An interesting method of putting out the roaring flames of a burning gas well was recently made use of in the Argentine Republic. The gas, which came suddenly and with great pressure while an oil well was being drilled, was accidentally set afire by an electric spark.

Fifty million cubic feet of escaping gas a day furnished a blistering torch that could be seen for miles. The gas as it escaped from the top of the well casing, which stood some four feet above the surface of the earth, formed a stream like a bar of iron, while the heat in the lee of the flame was unbearable.

The well burned thus for two months, while the people in charge invented extraordinary methods for putting it out. All the neighbors said they could do it, but only one actually succeeded. The method employed follows:

Around the large, eight-inch casing of the well a partly hollow clamp was tightened. Into this clamp was poured a collar of lead. This when it cools seals the pipe. This work was made possible owing to the fact that the flames did not begin until the escaping stream of gas had reached a height of about twelve feet above the earth. Thus the coolest spot was close to the well casing itself.

The upper portion of the mammoth candle-snuffer was made separately and was hinged to the lower part by means of the two curved metal extensions which (as shown in the accompanying illustration) extend to the left of the well casing. This upper portion of the apparatus was equipped with a metallic ring, A, which



Courtesy of "Engineering and Mining Journal-Press"

How the 150-foot gas flame was extinguished

was sharpened at its lower edge, like a cookie-cutter, so that it would penetrate the lead filling in the clamp, B.

The whole device was next tipped over the well on its improvised hinges by means of ropes pulled from a distance. The sidebolts were then clamped, and the eight-inch pipe for leading the gas away from the well was connected to a pipeline.

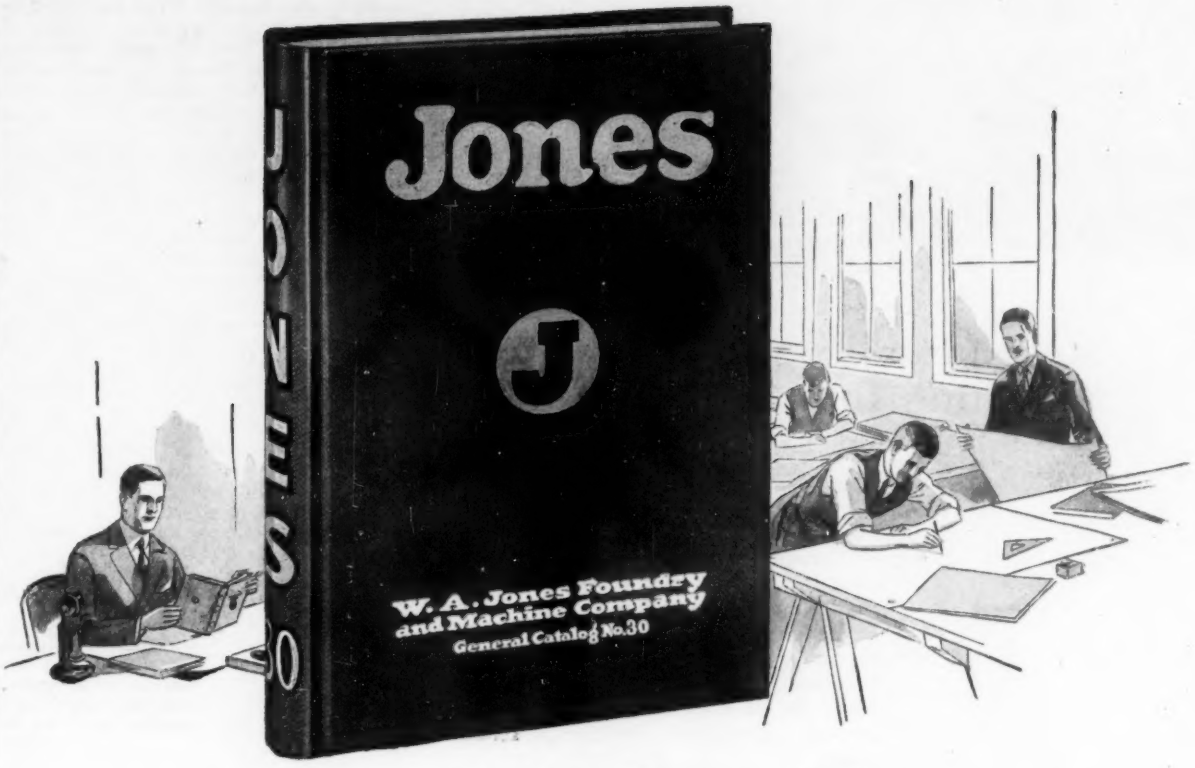
The upper valve was then closed and the fire went out.—*Engineering and Mining Journal-Press* (New York), vol. 118, page 939, Dec. 13, 1924).

* * *

Taking the Jerks Out of Towing

A new principle, whereby disabled ships may be towed at sea with far simpler towing tackle than we have ever been able to use before has been perfected. The new method of towing makes use of an auxiliary steam engine mounted on the after deck of the towing vessel. This engine is equipped with a drum or spool and an automatic device which causes the towing hawser to unreel against friction when the towed vessel is struck by a wave and suddenly surges backward. Then, when the jerk of the towed vessel is moderating the engine respools the pulled-out hawser. Thus, the new method of towing resembles the method used by wise fishermen when they trawl for heavy fish—no matter what the fish does they always keep a uniform tension on the fishline.

There are three general methods of towing ships. One is simply by means of a rope hawser, stretched between the two vessels. A second is by means of a towing engine designed to check the rearward surge of the towed vessel by means of a nearly equal and opposite pull on the hawser. The third and latest method is to let the vessel surge, keeping only a light pull on it until the wave that



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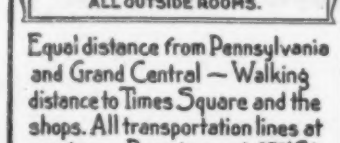

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makes it balk has passed, and then reeling in the line again.

If you should attempt to tow a heavy vessel at sea simply by means of a heavy hawser of short length, you would soon discover that no matter how strong the hawser was it would snap like a thread when the wave motion brought the towing vessel on the front of a wave and the towed vessel on the rear of one.

Before the days of the automatic towing engine seamen attempted to supply elasticity and spring to the hawser by using extremely long and elastic hawsers. Manila ropes of eight-inch diameter and more than half a mile in length were frequently made necessary in rough weather in order to provide enough elasticity to take up the sudden jerks of the towed vessel. Even then, many of these giant hawsers parted.

The next advance that came was the commercial towing engine. It was a great stride in the right direction but it was only one stride, for it operated on the principle of trying to check too rapidly the jerks of the towed ship. Thus it still made extremely heavy bulky towing tackle necessary.

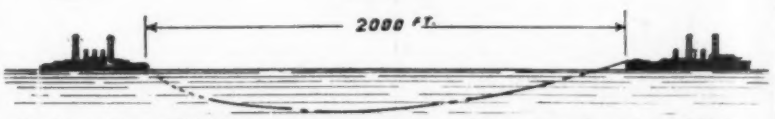
dragging two-and-a-quarter inch hawser accomplished, and it does it by means of a comparatively short 400-foot length of wire rope only one inch in diameter with a normal sag of only two feet. This remarkable simplification of the towing equipment is made possible by making but one simple change in the automatic device which controls the winding action of the steam towing engine.

Instead of meeting the powerful backward surge of the towed vessel by an almost equally powerful forward pull of the towing engine, the new automatic tension engine gives way when the stress is strongest and then slowly draws the ship up again when its backward pull, owing to the wave motion, is less than normal.

In other words, it bides its time until the wave which has caused the towed vessel to surge violently backward has passed, and then when the vessel is on the forward-sloping side of this wave the towline is wound up. The new towing engine thus endeavors to maintain only an 18,000-pound pull at all times.

All this seems simple and it is simply what the wise fisherman does when he sees that the

Towing with only a 400-foot tow line, weighing one and one-quarter tons and sagging but two feet. Speed 10 miles per hour



Towing with a 2,000-foot tow line weighing twelve tons and sagging 200 feet. Speed six miles per hour

When the towed vessel was following behind in good behavior the hawser would remain wound up on the drum or spool of the towing engine with a steam pressure of only twenty pounds per square inch. As soon, however, as a great wave struck the towed vessel the hawser would start to unwind. This in turn actuated certain mechanical connections and opened the steam valve, raising the pressure of the steam to perhaps one hundred pounds per square inch, thus opposing the pull that would otherwise unwind the hawser. The chief purpose for devising this automatic action was to prevent paying out too much hawser. Unfortunately it threw large stresses on the hawser during the few moments when the hawser most needed coddling. As a result, long and heavy, sagging hawsers had still to be used in order to cope with the great stresses thus put upon them.

For towing a fifteen thousand ton vessel at nine miles per hour in a calm sea a hawser pull of only nine tons would be required. In a rough sea, however, it is necessary to use a hawser having a breaking strength of about twenty times nine tons. At best, towing with hawsers used in this manner is towing by jerks.

Since much coastwise towing is done in only about five hundred feet of water, the big, long, heavy hawsers of steel-wire rope which were used often dragged along the sea bottom. Not only did this dragging wear and weaken the middle of the hawser, but it added resistance to the forward motion of both vessels.

For example, a 2,700-foot steel hawser two and a quarter inches in diameter on which the tug exerts a horizontal forward pull of ten tons sags down into the water 420 feet, and, owing to the frictional resistance of the water through which it moves, at seven miles per hour it drags the tug back about five thousand pounds, even if it never touches the sea bottom. This great and lengthy cable, having a breaking strength of 342,000 pounds, is required in order to exert only a 15,000-pound pull on the towed vessel. Such a cable would weigh about ten tons.

The new automatic tension engine, invented by Spencer Miller (Lidgerwood Manufacturing Company) does what the old-style engine and the half-mile of cumbersome,

attempt to pull a large fish in too rapidly will surely endanger his slender line: he lets the fish run, always keeping a light but uniform braking tension on the fishline.

This, in effect, is about what the new towing engine does and that is why a slender, one-inch steel hawser only a few hundred feet in length can safely and steadily tow a ship in a heavy running sea which by former methods requires a half-mile of heavy sagging bottom-dragging wire rope of far greater strength.—*Marine Engineering and Shipping Age* (New York), vol. 29, pages 657-662. November, 1924.

* * *

Putting Factory Methods Into Coal Mining

THE patient, plodding mine mule is rapidly being supplanted by prosaic power. Mined coal that was formerly shoveled up from the floor of the mine by hand and thrown into little dump cars drawn by mules is now being handled by means of the Movor, a conveyor of the continuously moving belt type.

The conveyor, a section of which we show in an above-ground set-up, is kept moved up within a few feet of the working face of the coal seam which is being mined. Thus, when the explosive shots that break down the undercut coal are fired, a part of the coal actually falls on the Movor, while the rest is so close to it that the labor of starting it on its journey towards daylight is comparatively inexpensive. This latest method of mining coal, resembling in certain of its aspects the conveyor-belt method of assembling motor cars, is simply another application of modern methods of doing things in uncommon but common-sense ways.

At the onset the new method of getting coal out of mines makes it necessary to lay out the mine in a decidedly new manner. This is called the "V" system. What, then, was the old system which it is hoped the newer one will supplant?

Let us imagine a horizontal, or nearly horizontal seam or stratum of coal, perhaps six feet thick. Above it and below it are rock. How would you go about it to get this coal out of the earth? To do this there have been two general methods.

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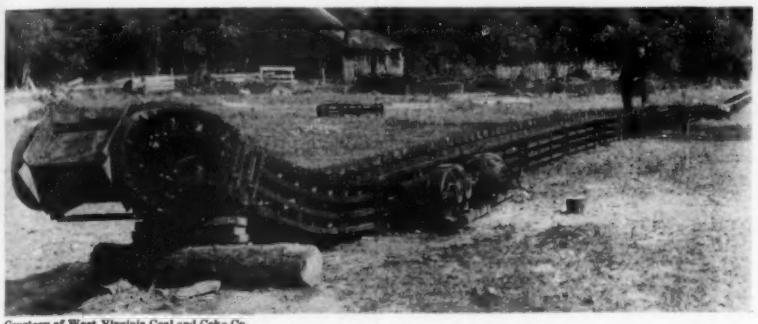
One way is to mine out the coal in chambers, leaving enough coal in pillars to keep the roof of the mine from caving in and crushing the miners. A sketch of a mine of this type is shown on this page. The many little oblong figures represent the pillars of coal that had to be left unmined in order to support the roof. In most cases these pillars have to be abandoned for all time. In a few places they are removed afterwards, but as this work allows the overlying rocks weighing millions of tons to cave in, it is a dangerous process. The pillar-and-chamber method of mining is the least expensive system, but it is the most wasteful. The better but more costly method is the caving system, which leaves no pillars.



Courtesy of West Virginia Coal and Coke Co.

Mechanical snake supplants the mine mule

In the caving system there are no little rooms, and no pillars are left. The miner can look along the face of the coal seam perhaps for a hundred feet. Just as a skirmish line of soldiers advances without any one of them getting in front of the rest, so the miners keep mining away the coal seam to a uniform distance, while the roof of the mine keeps sagging some yards behind them. This system, which is required by law in most parts of Europe, extracts all of the coal.

The new "V" system, originated by G. B. Southward, Chief Engineer of the West Virginia Coal & Coke Co. (Elkins, W. Va.) is a modification of this long-wall system of mining.

Courtesy of "The Explosive Engineer"

After the coal is blasted off, the mechanical snake conveys it toward the mine mouth

In the "V" system the walls from which new coal is mined are planned in a series of sawteeth—a row of letter v's. The Movors, each driven by means of an electric motor, are installed along the sides of the v's and they convey the coal out through prepared passages to other conveyors. These conveyors in turn take it to the main haulway of the mine. From here electric mine locomotives start the coal towards daylight.

The new system has, it is claimed, many advantages. Owing to the fact that long instead of short faces of the coal seam may be undercut before they are blown down with explosives, the coal is not broken up so much and at least fifty percent more lump coal is produced.

Again, since the work is concentrated in comparatively small space, the haulage of mine timbers, the drainage of water and the ventilation of the mine are much simplified. Close supervision of the miners is also made possible and this brings about more efficient work than was the case where little groups each consisting of two miners were left alone for hours in isolated chambers.

As a consequence of these advantages of the new "V" system coal is being produced at a reduced cost.—*The Explosives Engineer* (Wilmington, Del.), vol. 2, pages 357-361 (Oct., 1924); *Coal Age* (New York), vol. 26, pages 711-714 (Nov. 20, 1924).

* * *

Adding Science to Soap

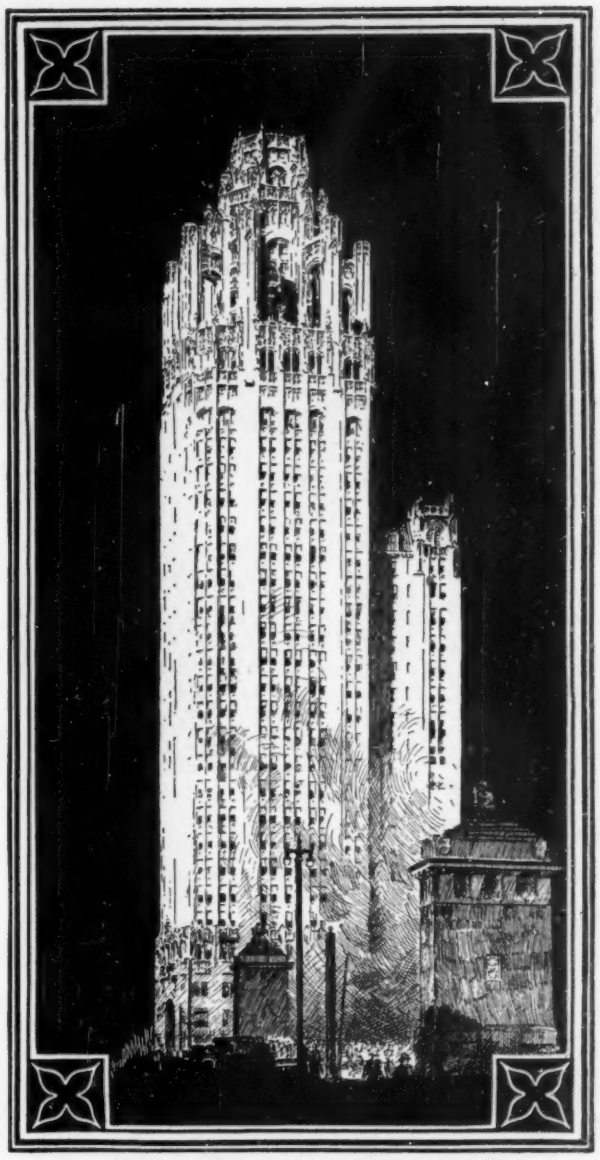
HERE is good news for the rising generation: laundries are to be trained not to batter garments to pieces nor to ruin them with strong chemicals. Laundering is to become a science as well as a trade.

There exists today a national association of launderers, most of whom are trying to do better work. This association is known as the Laundryowner's National Association and its headquarters are located in La Salie, Illinois.

These laundrymen, banded together, are trying to accomplish two important reforms. They are trying to teach themselves the necessary chemistry, the microscopy and the mechanics of the science of laundering so that each garment laundered will receive the exact treatment it should receive, and no other.

Likewise they are trying to show the public that the reason why so many garments go to pieces during the laundering process is that many of these garments have been manufactured by tricky methods intended to deceive the purchaser or that they have been injured by little knifecuts or by the work of the moth. In addition to this, there are many kinds of misleading fabrics which have only a weak framework and when wet are as loose as tweed and easily pull to pieces.

There was a time when laundering consisted simply of putting things into tubs and washing them. But a reading of the "Manual of Standard Practice for the Power-laundry Washroom," written by the Department of Research of the Laundryowner's National Association, would soon convince the reader that the modern trade of laundering is vastly more complicated than most people suspect. The modern laundryman must understand chemistry, for he must know what chemical com-



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binations and recombinations take place in his vats when various cleaning substances are added.

When the laundryman comes to know the why of what happens in good and bad laundering processes he will be in a far better position to know how to secure satisfactory results. The manual just mentioned clearly indicates that some, at least, of the new-fashioned laundryowners are trying to learn their trade. This book is, in this sense, a revelation. Except, however, as an exhibit of the nature described it is not the kind of book which would interest the average home-owner—unless she, or he, were something of a chemist.

However, another book, "The Conservation of Textiles," by Elledge and Wakefield, of the Mellon Institute of Industrial Research of the University of Pittsburgh, (same publisher as above) is admirably suited to the average home-owner. It shows what woolen, cotton and other fibers look like under the microscope. It puts fabrics bought at retail stores under the microscope and shows why many of them, although presenting an excellent outward appearance, are structurally so weak that they cannot long hold together when wet. It teaches the home-owner, as well as the laundryman, which one of the several available cleaning substances for removing stains such as tea, ink and so on, may and which may not safely be used on various kinds of fabrics.

* * *

Trading Civilization for Copper in the Belgian Congo

THE rich Katanga copper mines of the Belgian Congo have already made that colony the third largest copper producer in the world. To get the ore out and take supplies in, the Belgian colonial government is now building a seven hundred mile railroad which will connect the copper district, as well as a neighboring Congo cotton district, with a tributary of the Congo River. This will connect with the Atlantic Ocean by way of river steamers and an already existing railroad. This railroad will be completed in 1927.

The Congo is rich in mineral and other wealth, waiting for means of access. In addition to copper there is tin and coal. In the gravels of the southern Kasai district, diamonds are now being mined in quantities equivalent to about one-fifth of the output of the famous South African diamond mines. Gold is now being mined at Kilo and at Moto, in the extreme northeastern part of the Congo, near Lake Albert.

Katanga, the southern terminus of the new railway, where copper is now being mined on a very large scale, is near the border of Rhodesia. Nearby, as distances go in Africa, is the Sankuru district, where cotton is being grown. The railroad will take these products to the Kasai River, a large southern tributary of the Congo River. From here they will go down by steamer to Stanley Pool and then by rail to the seaport of Matadi, on the Atlantic.

Another railroad will extend from the Kilo and Moto gold lode near Lake Albert to the Congo River. By means of this project, which is now being surveyed, the Nile will be linked with the Congo!

In addition to railroads the Belgian Colonial department has been building trunk motor roads. In this manner, by connecting Nyangara in the Belgian Congo with Redyaf in the Anglo-Egyptian Sudan, and by equipping the motor service with government-owned and operated motor cars the last missing link on the Cape Town to Cairo railroad-steamer-motor route has been filled in. Thus travelers may now ride all the way from Cape Town to Cairo. The trip should take about four months, counting the journey down from Europe to South Africa and from Egypt back to Europe.

When the new railroad is done one may choose to go instead by present routes up through South Africa to Katanga, down across the Belgian Congo to Stanley Pool on the Congo River and out by way of Matadi to the Atlantic Ocean again.

Not only is the Belgian Colonial Department building railroads and highways, but it is laying the foundations which should relieve the terrible conditions under which the Congo negro lives. Instead of educating the negro along European lines, they are teaching him trades, and especially they are training him how to live hygienically and morally.

Six special training schools are now teaching the more intelligent natives practical hygiene, small surgery, and the treatment of the principal diseases that ail the natives in the Congo. The course requires three years and the graduates will in turn teach the masses. It is believed that sound ideas of sanitation and hygiene will penetrate more easily into the mind of the native if they come to him from men of his own race. In time, this will bring about the end of the harmful native witch doctor.

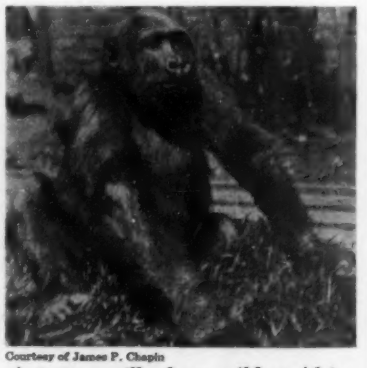
Domestic slavery among the negroes is being done away with, industrial schools are teaching him trades and his general betterment is being sought, although it will be a slow process with many discouragements.—*Journal of the Royal Society of Arts* (London), vol. 72, pages 711-722 (Aug. 29, 1924).

* * *

Saving Man's First Cousin The Gorilla

THE gorilla, rarest of the anthropoid apes, no longer remains in danger of complete extinction at the hands of big game hunters. Through the efforts of Carl Akeley, the well-known naturalist-explorer of Central Africa, and other scientists connected with the American Museum of Natural History (New York), the Belgian government has been prevailed upon to set aside a gorilla sanctuary in the Belgian Congo. Hereafter no hunter will be permitted to shoot any gorilla within this reserve which includes three mountains which are already the home of a group of these interesting simians.

There are probably only a few hundred gorillas in the whole world. Chimpanzees, which also come from Central Africa, are comparatively common. It is the chimpanzee, however—not the gorilla—that one so commonly sees performing tricks in the moving pictures.



Courtesy of James P. Chapin

A tame gorilla from wildest Africa

In most of his physical characteristics the gorilla is the closest relative of man. There are four apes which, because of a number of distinctive characteristics, are grouped together. These are the gorilla, the chimpanzee, the orang-utan and the gibbon, and they are termed the simiidae. They stand closest to man of all the animals. The first two are found only in Africa; the last two only in the East Indies. Of the four, the gorilla and chimpanzee are quite the closest to man, the former being closer physiologically; the latter closer psychologically.

Scientists are extremely anxious to forestall the extinction of the gorilla, not only because they wish to make extended studies of his anatomy and physiology, but they hope to study his habits in his own natural surroundings. They want to learn exactly how his mind works. This cannot be accurately determined by observing gorillas in captivity because gorillas do not behave the same in captivity as they do in their native forests.

Big game hunters have recently killed a large number of gorillas, the hunting party of the Crown Prince of Sweden having, it is said, taken the lives of several.

When Carl Akeley returned from his gorilla expedition in 1923, he brought with him the results of studies and observations which showed that the majority of beliefs we had held about the gorilla were untrue.

Akeley's observations were made at the same spot that is now being set aside as a

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perpetual gorilla reserve. This tract of land is situated in the northeastern part of the Belgian Congo between Lake Kivu and the Uganda and it includes the three volcanoes—Mount Mikeno, Mount Kirisimbi, and Mount Visoke. Nowhere else in the world can the great man-like apes be studied to better advantage. The gorillas living in the reserve will be able to go up or down the slopes of the mountains whenever they please. In this way, whatever the weather at the time, they can always find a temperature that suits them.

Akeley proved that the popular conception of the savage gorilla is a myth. Instead of aggressively attacking hunting parties and biting off the ends of their rifle barrels, he found them shy and retiring. However, in a close fight, were it forced on them, he believes no animal living could best the gorilla. Its tremendous frame and massive musculation, many times stronger than that of a man (even were the man of equal size) would provide a safe defense against the lion, the buffalo—even the elephant.

The writer enjoyed an opportunity to test the strength of a gorilla when he spent an hour with the young John Daniel, 2nd, within recent months. This ape was then about three years of age, weighed eighty pounds and stood nearly four feet tall. His legs were very short, but from the waist up his body was about as brawny as that of a powerful blacksmith, the arms especially being very long and strong, and the paw, which is really a hand, as long and strong as that of a six-foot stevedore. In a clinch this ape, although but a baby, proved to be a doughty opponent, while his too-playful tendency to bring his powerful teeth into action, biting the neck and arms, finally won him the argument.

As if answering the old question concerning whether gorillas do or do not drum on their chests with their fists, John Daniel did drum, many times, not only on his own chest, but on the writer's back. It was not done in anger, however, but evidently for the same reason that a man often tenses his muscles—a sort of self-demonstration of strength. The drumming was rapid, producing a resonant noise. It was not done with the fists, but with the edges of both hands.

We know very little about the somatology of the gorilla because very few scientists have ever had the opportunity to dissect one. It is possible to demonstrate that many parts of his soft anatomy are closely related to the homologous parts of the anatomy of man. This applies especially to the nose, the ears, the teeth and the feet.

By studying the anatomy of the simiidae, including that of the gorilla, and by studying their habits and psychology when they are at home in their native forests it is believed by many anthropologists that as much can be learned concerning man's early relationship to the apes as we can learn by the slow discovery of fossils.—*Natural History* (New York), vol. 24, page 620 (Sept.-Oct. 1924).

* * *

The Horse of a Million Years Ago

SCIENTISTS of a recent geological expedition sent to Texas by the American Museum of Natural History (New York), have discovered in rocks more than a million years old the fossil skeleton of a horse in one of its ancestral stages of evolution.

In the evolution of the horse the newly found specimen represents an intermediate stage between the type called *Pliohippus* and the early Ice Age horse called *Equus*. It is smaller than the modern horse.

While the fossil horse just discovered is almost the earliest one-toed horse, long before the day of *Pliohippus* there had existed quite a number of more primitive or less evolved forms of the horse.

For example, if we go back to the Eocene Epoch, when the ancestor of the horse was no larger than a cat, we discover that he had four toes on his fore feet and three on his hind feet. The subsequent evolution of the horse is most clearly marked by the gradual loss of all of these toes except the single toe on which our modern horses walk. Other parts of the animal, especially the teeth, have also undergone a striking evolution, while the increase in size has been very great.

In order to place the newly discovered fossil horse in the proper place on the long scale of evolution, let us essay to follow out the main trend of this evolution.

If we begin close to the beginning of the

American Museum of Natural History

How the horse lost all but one toe

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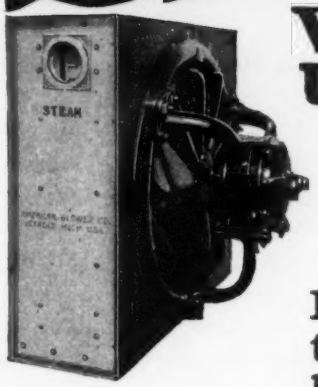

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Consider this:—Their tubes have five times the heating capacity of cast or wrought iron tubes of equal size. This is because the tubes are of copper and are wound with helical "fins" to increase their surface.

Easily and quickly installed

Venturafin Units are so light they can be loaded on a hand truck and transported by one man. Their light weight makes installation easy and does away with all necessity for special supports. From one to four can be mounted in one recirculating box (see illustration) and placed anywhere in any building where 5 lbs. steam pressure is available.

Write for Bulletin No. 1218, giving engineering data and prices on larger sizes.

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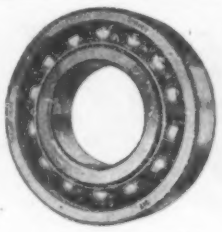

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No matter what the requirement, there is a Gurney Ball Bearing especially made for that purpose.

Gurney Maximum Service-Maximum Capacity type bearings, including Radial, Radio-Thrust, Duplex and Double Row, have the peculiar merit not found in any other design of ball bearing in that they have the maximum number of balls of maximum diameter for any given size of bearing, thereby giving maximum capacity with minimum unit stresses in materials. These bearings are suited for heavy loads and hard service at all speeds.

Type "C," deep groove bearings have deep, uninterrupted raceways and will take light thrust loads from either, or both directions and are especially suited to the ever growing demand for light loads at high speeds.

We have a type for your needs—write for the assistance of our engineers. 18273

Marlin-Rockwell Corporation
SUCCESSOR TO
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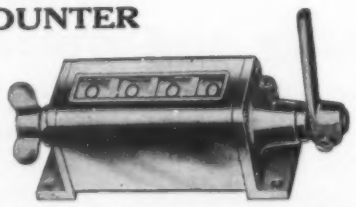
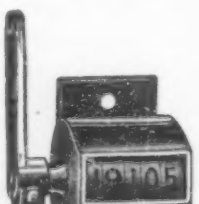
Production's "Before-and-After"

Is there any machine that can't be improved—or better operated? It's not so recorded on a Veeder Counter. When a counter goes on, production *goes up;* either the inventor gets busy or the operator gets *busier* on the job! With every change in method or mechanism you get the "before-and-after" picture, as reflected in *production* on a

Veeder COUNTER

The large Set-Back Revolution Counter at right is shown less than ½ size. The small Revolution Counter below appears nearly full size.





The Re-Set Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, according to purpose. Price, with four figures, as illustrated, $10.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

EVERYTHING you may need in a counting device goes to make up the 80-page Veeder booklet. Production Counters, Speed Counters, Hand Tally Counters and others. Copy free.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

Tertiary Period or great age of mammals we shall find the horse already evolved to the stage called *Eohippus*. This little cat-like creature may be pictured as trotting along over the broad low-lying river valleys of subtropical, volcanic Wyoming. He already depended on his fleetness of foot for protection against the carnivorous animals which were rapidly evolving at the same time.

Although he had but three toes on either hind foot, there remained the rudiments of two additional toes which had already begun to disappear. Oddly enough the soft rocks in which the fossil bones of horses in the early Eocene stage of their evolution have been found were formed at about the same time as the oil shales which we expect some day to use for our oil supply. This fact may, however, be regarded only as an interesting coincidence.

A few hundred thousand years later than *Eohippus* came the primitive horse *Orohippus*, whose skeletons were fossilized in rocks of the Badlands of Wyoming. *Orohippus* was the size of a small dog. The two rudimentary toes of his ancestor, *Eohippus*, had already disappeared, leaving, however, the same four toes on the fore feet and three on the hind feet.

The next stage is *Epihippus*, still an Eocene Epoch horse. He was not very different from *Orohippus*, except that the central toe of each foot was beginning to grow larger than the outside toes.

Mesohippus, the horse of the Oligocene Epoch, was about the size of a pointer dog. The middle toe was not only much larger than the side toes, but it now bore most of the animal's weight.

The next epoch was the Miocene, lasting perhaps half a million years, perhaps longer. *Parahippus* of this remote day still had three toes but only one toe touched the earth. The second and fourth toes were small, while the ancient fifth toe of the fore foot was now only a very short, small splint which served no purpose at all.

At about the middle of the Miocene Epoch, close to two million years ago, perhaps more, the descendent of the little cat-sized *Eohippus* with which we began our account had reached the size of a very small donkey. To this stage the name *Merychippus* had been given.

Do not assume that these names represent separate creatures in the sense that such names as rabbit, pig and dog represent separate animals. The evolution of the horse was a gradual thing, and when we apply these names to its sequence of types what we do is simply to put our finger on the thread of the evolution at conveniently separated periods of time and say, as it were, "Let us arbitrarily name this evolving animal at various stages in its evolution, so that we can designate them more or less closely.

Pliohippus was the horse of the early Pliocene Epoch. The two remaining side toes have now been reduced by evolution to long, slender splints which do not even protrude through the skin. *Pliohippus* was not very much smaller than the modern wild horse, although it must be remembered in making comparisons that the draft horse with which we are familiar is not a fair criterion of size, since through artificial selection he has been greatly increased in height and weight within comparatively recent times.

Pliohippus lived at the same time when man was probably changing from the ape to the ape-man. Back at the beginning of the evolution of the horse the ancestor of man was some uncertain type of small creature which the popular word monkey would loosely cover. Probably, however, he was even smaller than the little Cebus monkeys which accompany organ grinders.

Thus the ancestors of man and the horse evolved together, in time though not in place. But just as man was not man as we know him until about a million years ago, so the ancestor of the horse was not the horse we know until some time during the Glacial Epoch.

During all this time the other mammals were also evolving. Closest to the group of early horses whose evolution we have just reviewed are the great extinct titanotheres whose mammoth fossil bones have just been found in Mongolia; the tapirs; the rhinoceroses and a few other extinct types of creatures. It is true these animals do not impress us as having much or any common relationship, especially with the horse, yet a study of their skeletons rather than their external forms shows clearly that they are related. Particularly is this shown in the bones of the foot, for they are the odd-toed suborder of mammals, and this differentiates them from the other hoofed animals. Especially is the form of the astragal or ankle bone and the os calcaneum peculiarly characteristic of this group.

If we go back still further we find that other groups of mammals were evolving at the same time, so that we can bring into relationship the ancestors of the carnivorous animals, and such commonly known mammals as the pig, the camel, the elephant, the bat, the whale and scores of others. If we trace their evolution back far enough we discover that the branches of their great family tree of the mammals coalesce, probably in some small insect-eating form of animal which dwelt during the days of the great extinct dinosaurs. But of them all, we know the evolution of the horse and his cousins, the zebra and the ass, most fully.—*Natural History* (New York), vol. 24, pages 629-631, September-October, 1924.

* * *

Will Reindeer Steaks Take the Place of Beef?

REINDEER meat will soon take its place in the Pacific Coast states as a staple market product for table use if its popularity continues to increase at the present rate. In 1923, ninety tons of this meat were shipped from Alaska to the United States. Herds of reindeer are now being kept and tended in Alaska in much the same manner that great herds of beef steers are kept on Texas ranches.

There is no good reason why reindeer should be regarded as an unsuitable meat for regular table use. In Nome, Alaska, for example, according to the arctic explorer Vilhjalmur Stefansson in "The Northward Course of Empire" (Harcourt, Brace and Co., New York, 1922), reindeer is as common a table dish as beef is here. In Nome the residents would be most surprised to learn that the eating of reindeer was even regarded here as unusual.

Reindeer increase rapidly. A herd doubles in three years. The history of the reindeer herding industry in Alaska is interesting when regarded in this light. Between 1892 and 1902, twelve hundred and eighty reindeer were imported from Siberia. By 1903 this herd had increased to 6,000. By 1918 the original handful of imported reindeer had increased to 120,000; while in 1923 the entire number of reindeer in Alaska totaled about 241,000.

These herd reindeer are not wild, any more than the great herds of cattle that graze on our western prairies are wild. Man has learned that science can be made to aid in the rearing of the reindeer. The Biological Survey of the United States Department of Agriculture maintains important experimental and scientific work among the Alaskan herds, for like all other creatures, reindeer have their own diseases and parasites.

Reindeer are simply domesticated or semi-domesticated caribou. The tundras of the north, reaching from the great forest belt of Canada to well within the arctic circle support literally millions and millions of caribou. Their food is moss and other tundra vegetation. Seeking this food in winter they cut through snow and ice with their sharp-edged hoofs.

Someday, perhaps a hundred years hence, we may find our country over-populated. If by that time we have not yet found some short cut to an artificial food supply all our available acres may have to be devoted to vegetable growing. Then there will be no room left for the herds of beef cattle that rove over the ranges of the west.

When and if such a condition arrives we shall then be ready to make use of the millions of caribou in the Arctic. At present, although caribou is excellent and tasty food, it cannot compete on an even basis with beef. It is too far off, too inaccessible. Its shipment from the north costs too much.

MARLIN-ROCKWELL CORP. *and* THE VEEDER MFG. CO. *have our endorsement. In dealing with them please mention* SCIENTIFIC AMERICAN.

Nor could herds of caribou possibly be kept in our latitudes. They cannot live at all on the forage that is available here. Their digestive organs, adapted to the mosses of the tundras and to vegetation of the kind which does not grow here, cannot long withstand any other diet. Caribou have been brought to the New York Zoological Park, but their food had also to be brought from the north in bales. Owing to the difficulty of drying this fodder properly these bales usually overheat, and fungus sooner or later becomes established within them. Eating this infected fodder kills the caribou.

Therefore, when one reads over-optimistic predictions about using the north as a great food source in which the caribou are to be kept by the millions in domesticated herds, slaughtered and sent here to take the present place of beef and other meats in our diet, one must assign this consummation to a long time in the future. Although reindeer steak can now be brought to the Pacific Coast states reasonably cheap, the cost of refrigeration on shipments to the east will for a long time prevent it from making beefsteak a rare dish.

How to Keep People Out of the Wrong Place

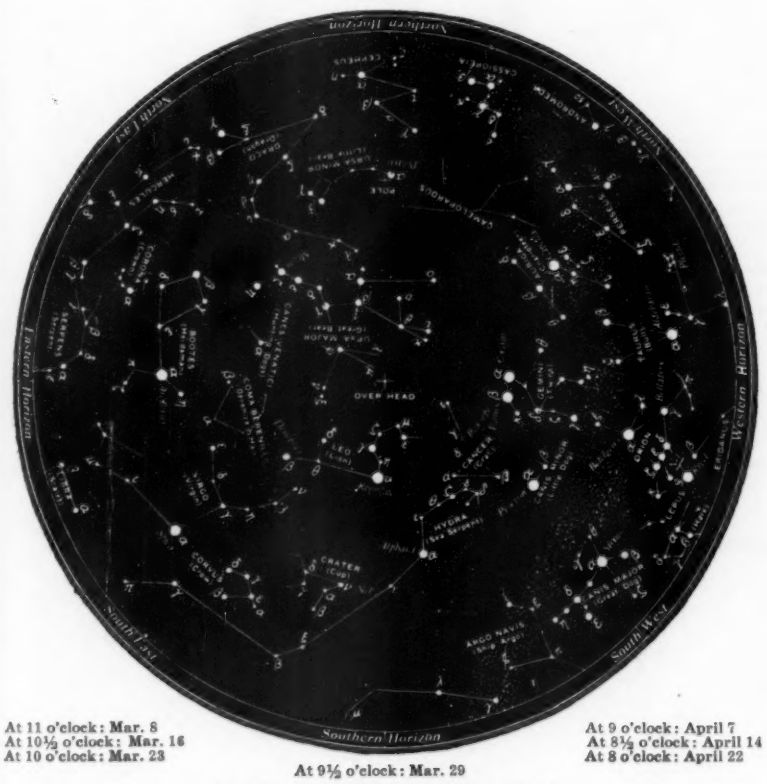
If you have machinery of the kind that embodies exposed gearwheels, lathe spur gears, or any other moving parts which are a potential danger to those who come near, the best method of keeping these people in the right place is to install metal guards which cover the moving parts completely. This work can be done at surprisingly low cost, preferably by using expanded metal.

How to measure for such guards, and how to build them is plainly told in a booklet entitled "Guarding Machine Tools," which is published by the American Museum of Safety (New York) and sold at a very nominal price.

Instructions are given for bending the angle iron used in stiffening guards of this nature, together with a copy of the Safety Code for Mechanical Power Transmission Apparatus as approved by the American Engineering Standards Committee. The booklet includes the rules for guarding dangerous machinery as formulated by the Department of Labor of the State of New York.

The Heavens in March

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Mar. 8
At 10½ o'clock: Mar. 16
At 10 o'clock: Mar. 23

At 9 o'clock: April 7
At 8½ o'clock: April 14
At 8 o'clock: April 22

At 9½ o'clock: Mar. 29

NIGHT SKY: MARCH AND APRIL

ON our star map for March and April we find that the great nebula of Andromeda, of which we speak in our article on page 165, has set at our hour of observation (although it is still visible, low in the northwest, in the early evening). Orion, Taurus, Gemini, Auriga and the Great and Little Dogs combine to make the western sky resplendent. The south is duller, although Leo is high and Hydra stretches out below. Virgo is in the southeast, Bootes in the east, Hercules and Corona in the northeast, Ursa Major high in the north, Ursa Minor and Draco below and Cassiopeia and Cepheus on the horizon.

The Planets

Mercury is an evening star after the 5th, and is well visible at the end of the month. Though he is but 19 degrees from the sun, he is 10 degrees north of him, and stands almost straight above the spot where the sun sets, remaining above the horizon till nearly 8:00 P.M. He is unusually bright, surpassing Capella and since he is in Pisces far from any bright stars he should be very easy to identify. Venus is a morning star, but very close to the sun and practically invisible. Mars is an evening star in Aries and Taurus, setting about 11:00 P.M. in the middle of the month. On the 22nd he is 3 degrees south of the Pleiades and looks nearly, but not quite, as bright as Aldebaran.

Jupiter is a morning star in Sagittarius and rises about 3:00 A.M. on the 15th. Saturn is in Libra and rises near 10:00 P.M. Uranus is in conjunction with the sun on the 12th, and is invisible. Neptune is in Leo, and crosses the meridian about 10:00 P.M.

The moon is in the first quarter at 7:00 A.M. on the 2d, full at 9:00 A.M. on the 10th, in the last quarter at noon on the 17th and new at 9:00 A.M. on the 24th, and farthest away on the 4th. While making her circuit of the sky, she passes Neptune on the 8th, Saturn on the 14th, Jupiter on the 19th, Uranus and Venus on the 23rd. Mercury on the 25th and Mars on the 28th.

It remains to be said that, at 10:17 P.M. on the 20th the sun crosses the celestial equator, passing over the vernal equinox.

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The designing and building of special furnaces for special purposes.

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The developing of apparatus for the efficient production of fuel gas from low grade lignite, wood refuse, sawdust, shavings, etc.

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Conducted by Alexander Klemin

Associate Professor of Aeronautics, New York University

Jumping Into Space

THE Air Mail service recently reported its first fatal accident since the inauguration of the night airway on July 1, 1924. Clarence O. Gilbert of long army service but new to the mail perished near Kaneville, Ill., when in a blinding snowstorm his motor failed and he decided to jump. He failed to clear the plane and the stabilizer cut the shroud or suspension lines of his parachute. Aviation accidents are rare nowadays; still more rare is a case where the parachute has failed to save the aviator. To its credit are now due some almost miraculous escapes. The technique of its construction and handling, thanks to endless experiment, has reached a remarkable degree of perfection, and according to C. G. Grey of the *London Aeroplane*, America leads the world in this vital part of airplane equipment.

United States Air Service

At the left is a front view of the parachute harness securely adjusted to the pilot's body and forming a comfortable swing-like seat when the parachute opens up. At the right is shown the parachute container. In this small pack is held the fabric which opens up to a diameter of twenty-four feet when the parachute is released by pulling the rip cord. Nothing is more ingenious than this pack parachute

The sole type that has survived is the so-called free-type-manually-operated parachute strapped to the body of the pilot, entirely disconnected from the airplane or dirigible, and allowing a man perfect freedom of action in the jump. Its construction is truly a wonderful product of human ingenuity. It has a surface of twenty-four feet diameter, landing a 180-lb. man at a velocity of some eighteen feet a second. And yet it only weighs eighteen pounds and when not in use occupies a minimum of space.

The fabric of this parachute is of the best Japanese silk, the strongest textile material in the world, yet with a "time lag" or give to it, which enables it to withstand easily the tremendous impact of wind pressure when it opens at high speed. It is cut in a series of panels, on a bias which increases the initial strength. A small circular vent at the top of the parachute also increases resistance to sudden impact by allowing an escape of air at opening, and filtration of the air through the fabric itself is of great help in this direction. The suspension or shroud lines are composed of four separate silk strands, loosely encased in a braided covering of silk. These strands are continuous, going from a ring on one side of the aviator's harness to the supporting fabric and then back to a ring on the other side of the harness.

The harness to which the shrouds are secured is of strong linen webbing of such form that the parachute jumper sits in it as if in a swing, with suitable straps and buckles to hold him in. Under the harness as a rule is the smallest and neatest container imaginable of duck canvas, with the cleverest arrangements for keeping parachute and shroud lines clear of one another on opening.

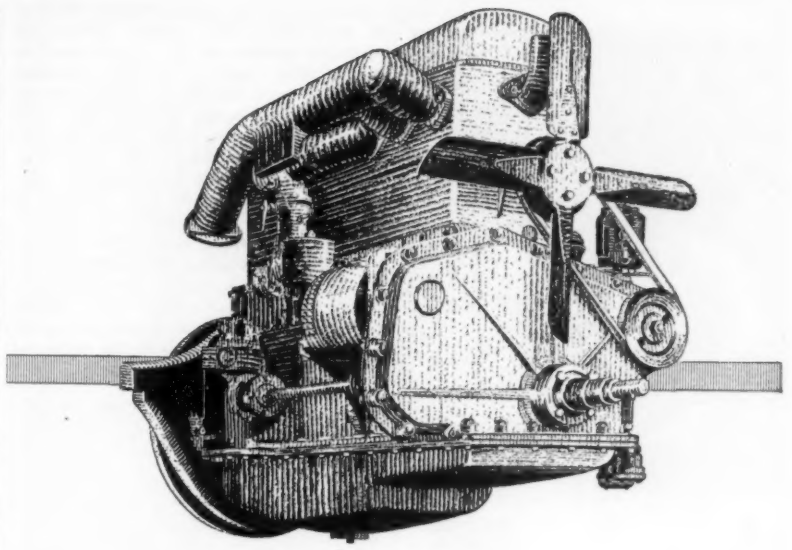
The majority of parachutes are equipped with a "pilot chute" which is a miniature structure made with ribs and spring (each rib made of steel) in umbrella fashion. When the pilot pulls the "rip cord," which is secured to the harness in the most natural and accessible position, the "pilot chute" springs out, catches the air and helps to lead out the main parachute faster and more positively.

All the jumper has to do is to stand on the wing, pull his rip cord and let the parachute pull him into space; or jump clear into space, pull the cord when clear of his plane and let the parachute do the rest.

There is nothing the matter with either the construction of the parachute or with the careful training which both the Army and Navy give in parachute jumping. But the matter of psychology still remains.

Corley McDarment of the Army Air Service tells us that the courage to jump is always worked up by aviators before the time for jumping comes. Aviators think the whole jumping process through and make up their minds ahead so that when the time comes they step out and otherwise act mechanically. Nevertheless, when a jump is made to avoid a catastrophe, the most hardened pilot experiences more than a thrill.

Frequent parachute jumping has exploded the notion that a violent dropping through space will cause a man's faculties to be



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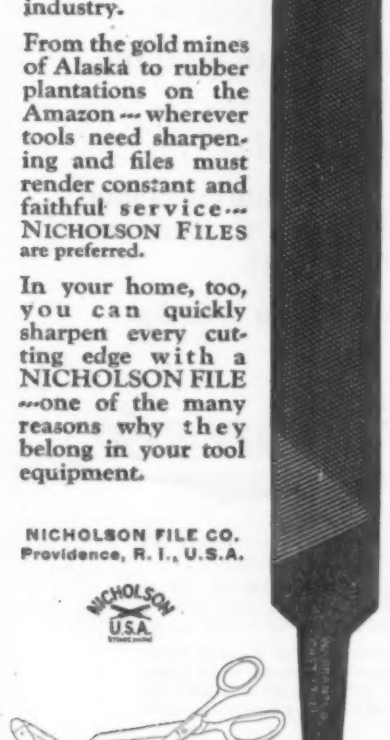

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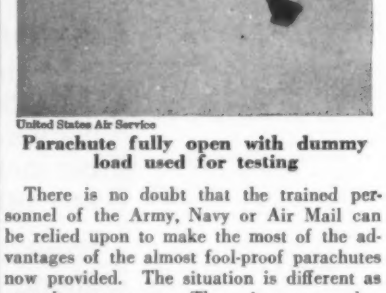
numbed. Free falls of as much as 600 feet or more have been recorded before the parachute opened yet the jumpers have retained clear control of their faculties throughout and the ability to pull the rip cord. Even after the parachute has fully opened there remains much skilful thinking to be done. The jumper sitting in his swing-like harness can check oscillations by pulling down on the shroud lines attached to the high side of the parachute at any moment. He can swing himself into the line of flight by swinging vigorously on the shroud lines, and he can avoid trees or other obstacles by similar maneuvering. Before landing he can grasp the webbing above his head, lift himself relatively to the chute and thus deaden the shock of landing.



United States Air Service

Parachute fully open with dummy load used for testing

There is no doubt that the trained personnel of the Army, Navy or Air Mail can be relied upon to make the most of the advantages of the almost fool-proof parachutes now provided. The situation is different as regards passengers. There is on record a flight at Bolling Field where an army plane got completely out of control at some 4,000 feet. When the Air Service officer told his sergeant to jump, an argument ensued till the earth was only 1,000 feet away. The officer had practically to lift his passenger out and push him over. It appeared that the sergeant had only drawn the parachute from supplies that day and was not sure that it would open. The position would certainly be much worse if the pilot had to argue with civilian passengers to become members of the Caterpillar Club, composed of men who have saved their lives by jumping. In fact it is almost unthinkable that the general traveling public could make use of parachutes in an emergency.

Many suggestions and patents have dealt with the possibility of parachutes which could remove the passengers and perhaps the cabin at the will of the pilot. That nothing practical has yet been developed is no proof that a satisfactory method will not be arrived at.

What Does An Air Line Cost?

WE have been asked by several correspondents to tell them what it costs to operate an air line. Such information is generally regarded as a valuable secret by operating companies, and scarce and unreliable accordingly. The United States Air Mail Service and the Compagnie Franco-Roumaine, operating between Paris and Bucharest, are exceptions to the rule and issue full annual reports.

Thus, for the fiscal year ending July 1, 1924, the Air Mail summarizes its costs as follows: Miles flown, 1,853,251; total flying time, 19,455 hours 25 minutes; total expenditures, $1,495,996; average cost per mile, 81 cents. A percentage analysis of every dollar spent shows approximately: Wages and salaries, 50.7; pilots' mileage pay, 7.2; fuel and oil, 10.8; repairs and materials, 7.1; tools, machinery and equipment, 11.9; rent, light and power, 2.7; fields and buildings, 2.1; telephone and telegraph, .9; expenses in connection with forced landings, .3; freight and express, 1.9; mileage scrip, 1.2; expense accounts, 2.4; miscellaneous, .8.

The Post Office has good accountants and these figures are scrupulously correct. But so much equipment in the shape of war machines and motors has been donated to the Mail Service by the War Department, so many expenses that would be incurred by a private company are charged to the Post Office Department as a whole, that these figures err on the low side. (It is interesting to note also that since the introduction of lighted airways last summer, costs have risen to more than a dollar a mile.)

The Franco-Roumanian Company has to pay for everything it gets and its analysis more nearly approximates that which would hold in the commercial operation of an air line. Its Bulletin No. 5 for the year 1923 gives the following distribution of a dollar: Depreciation, 25 cents; general technical expenditures, including pilots' pay, 20 cents; plane maintenance, 10 cents; motor maintenance, 12 cents; fuel and oil, 12 cents; motor car service, 4 cents; administrative costs, 12 cents; insurance, 5 cents. Flying about 810,000 miles the total costs were $850,000 or a little over a dollar a mile.

The Air Mail ships had a pay load of about 600 pounds; so that their costs ran to $2.70 per ton mile. The European company estimates its ton mile at nearly the same figure of $2.80.

Colonel Paul Henderson, broadcasting under the auspices of New York University, predicts, however, an ultimate cost of only 30 cents a ton mile. Even with a modern ship of better design but similar type to those used at present, the Post Office could double the pay load or halve the cost per ton mile. Certainly with huge multi-motored airplanes, carrying very much greater loads with practically the same operating personnel, costs would take a sharp downward swing.

A Flying Bomb

WE have heard of pilotless planes, designed to hail destruction on an enemy hundreds of miles away. Now comes a more practical Italian invention, whereby a flying bomb may be projected from an airplane at an objective which is *not* below the airplane. These bombs weigh about twenty-five pounds, are nearly five feet long, and ten inches in diameter. They are supported in the air by a small regular system of biplane wings of some eight square feet of area. In the small flying apparatus a wind driven gyroscope assures stability and a stabilizer is set to give a correct gliding angle. A cam, turning slowly under the action of a small windmill, changes the setting of the stabilizer at the correct moment so that the bomb then plunges vertically downward. With the bomb launched from an airplane at a height of a mile, Italian engineers estimate that an object eight miles away could be struck with precision.

Safety

AMERICAN engineers are not waiting for some miraculous new device to make the airplane safe. They are attacking the problem of safety from every angle and in a painstaking manner, embodying their findings in the American Aeronautical Safety Code. Part 1, dealing with Airplane Structure, Design, Fabrication and Tests has just been issued. Its most significant characteristics are a matter of fact, practical attitude and the assumption that much can be demanded of the airplane already. For example, an airplane must have "inherent longitudinal stability" and must be able to recover from a steep dive, or from a "stall" in which the nose goes up beyond the maximum permissible angle of flight without the intervention of the pilot. Another demand which the engineers expect to be met without difficulty is that the whole control system shall be so arranged that it is impossible for it to jam in any part as the result of any conceivable sequence of events!

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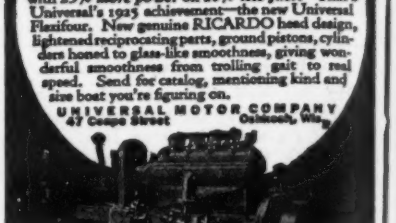

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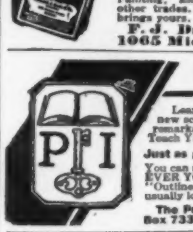

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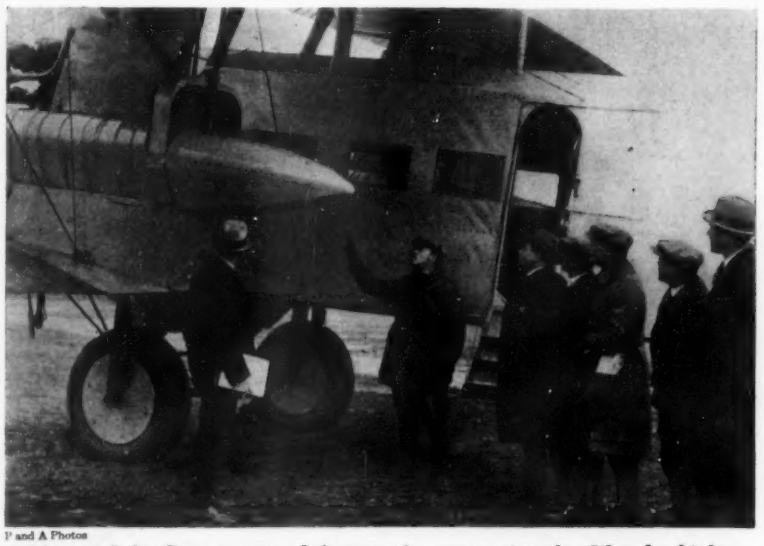
United States Air Service

The jumper in this photograph evidently walked out on the wing before leaping clear. The chute is opening up rapidly. The jumper will resume natural position, feet down, in a few minutes

If the Safety Code comes into force, it will not need a very husky individual to fly the ship; the force required to restore the machine from any abnormal attitude including vertical diving must not exceed eighty pounds on any control. A twin-engined airplane must be capable of flying straight or making a gentle turn when one motor is out of commission, and the propeller of the working engine is exercising a powerful turning movement to swerve the plane from its path. This, of course, increases greatly safety in case of power plant trouble, and means that a twin-engined ship will be assured at least of finding a suitable landing place if one motor quits. One of the requirements for seaplanes is that they must be seaworthy at anchor with a thirty-mile an hour wind and a sea rough enough to have waves three to four feet in height.

a De Havilland airplane crashed to the ground and the gasoline tank exploded, consuming the pilot and seven passengers in a fire of such intensity that onlookers were powerless to help. The provisions of the code will do much to avoid such contingencies. Tanks are to be located as far as possible from the engine, in the wings or in some other position, and not along the axis of the engine. Tanks are not to be placed inside of any enclosed or unventilated part of the structure where gasoline fumes might accumulate in case of leakage. Recommendations for the exhaust manifolds are also intended to reduce fire-hazard, and fire extinguishers are definitely imposed.

There is no doubt that careful work of this character will eventually render the airplane as safe as any method of transportation now available.



P and A Photos

Students of the Department of Aeronautics are testing the Sikorsky biplane, one of the largest passenger airplanes ever built, for performance in speed and climb, under the direction of Professor Alexander Klemin. Mr. Sikorsky has made a special effort to secure flight on one motor for his twin-engined ship, an important factor in airplane security

There are not many passenger air lines in operation in the United States. The code very wisely prepares for the day when passenger carrying will be a common matter. Passenger cabins must be properly ventilated, all seats fixed, two exits at least must be provided for emergencies. Grover C. Loening has recently suggested that crash-proof cabins might be constructed which would be immune from damage in the worst fall. Whether this is possible or not remains to be seen, but provisions for passenger safety include thick padding of all edges as well as of the front of the cockpit in order to prevent injury to the head of pilot or passenger on a bad landing.

As these lines are being written news comes of a terrible accident at Croydon. Shortly after leaving the airdrome for Paris

Maximum Streamlining

WHEN Lieutenant "Al" Williams flew at 266.6 miles per hour over a three-kilometer course at Mitchel Field, Long Island, on November 4, 1923, in a Curtiss-Navy racer, it seemed hardly possible that this record could be improved on. The Curtiss-Navy racer seemed to be also the very last word in aerodynamic and structural refinement. The speed record has now passed to France, where Warrant Officer Bonnet flew a Ferbois Monoplane at the Istres airdrome near Marseilles at 278.3 miles per hour.

It may be said that the palm of skill in racer design has also passed momentarily into French hands. The line drawings taken from the French *Aéronautique* indicate a maximum streamlining, which is truly re-

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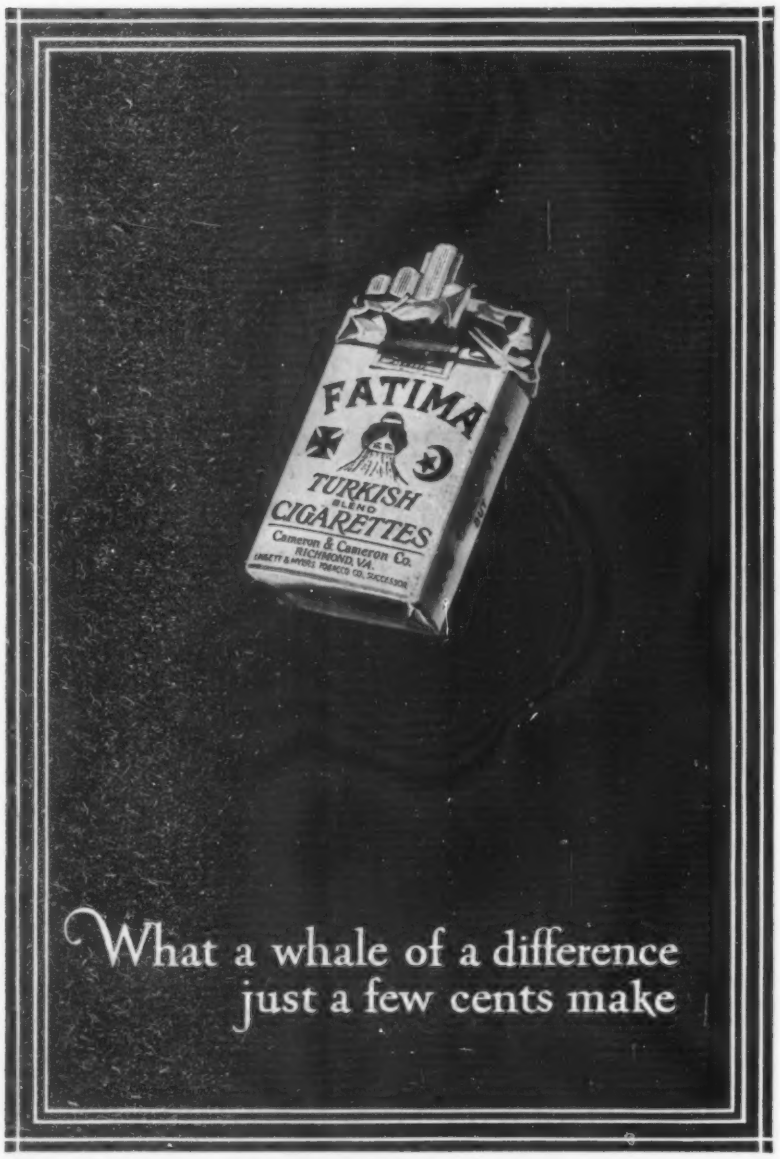

What a whale of a difference
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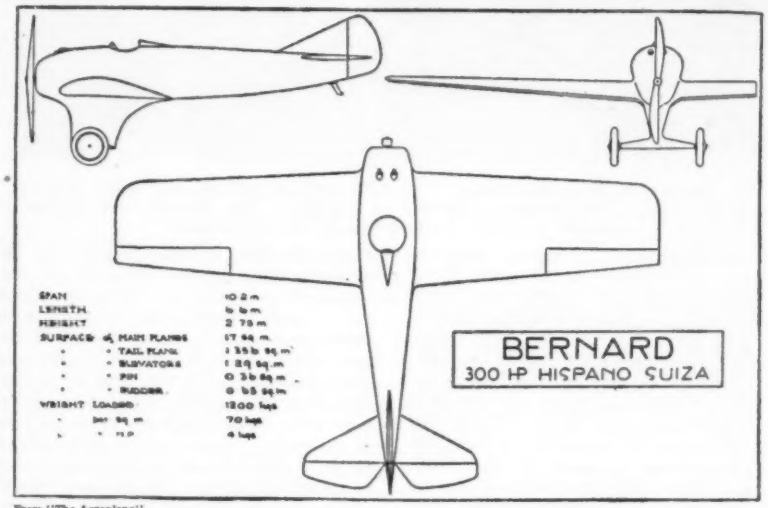
markable. The beautiful lines of the fuselage and cowling enclose the motor entirely except for the front part of the cylinder banks. The internally braced wings show not a sign of resistance-producing bracing, and taper gracefully from the root where they must be strong and thick, to the thinner tips. But the most remarkable streamline effect is in the landing gear. The fuselage tapers out into a streamlined mast which again flares out into a streamlined axle carrying the wheels. There are no struts close to wheels, no interferences of any kind, (and aerodynamic intereference may double the resistance of two parts when placed close together).



From "The Aeroplane"

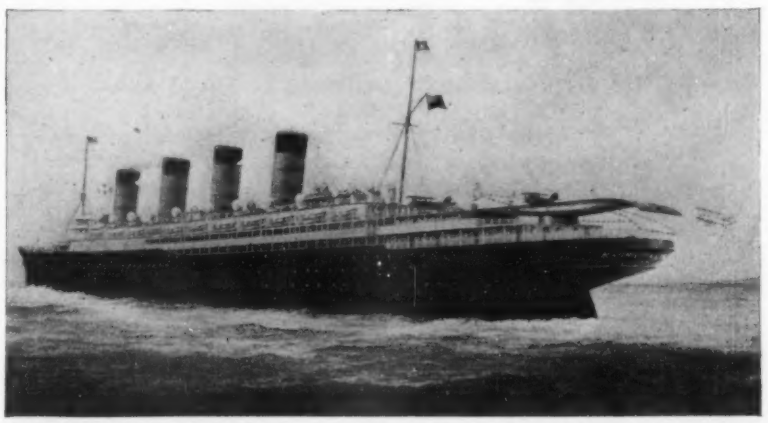
Outline drawing of the original Ferbois (Bernard) all-metal pursuit plane

Of course, such aerodynamic refinement does not make for cheapness or ease of construction, but without it even a 600 horsepower Hispano-Suiza engine could not propel a plane through the air at such a tremendous speed.

insure safe landing a "leg" of about six feet is used, which touches the ground as the plane comes down, cuts out all contacts, shuts off the gas and puts the stabilizing devices out of commission. Then an automatic brake comes into action and stops the plane within a 100 yards.

The pilotless airplane has performed the most intricate evolutions both under wireless control and under clockwork and barometric control.

In peacetime, M. Marcotte foresees utility for this type of craft, carrying mail or fast freight at heights making human flight impossible. With supercharges maintaining power in the rare atmosphere, immense speeds would be attainable. But there are drawbacks to the invention. "The pilotless airplane offers universal possibilities of a value beyond the scope of imagination. But one has to pay for everything one gets and here there is offered the menace of a merciless and terrible aerial bombardment, unless indeed secrecy is preserved as to the devices that would give France a preponderance in the air."



The Gibbons airplane landing and launching device (described in these columns in our February issue) as it would appear if installed on a large ocean liner like the S.S. Mauretania

Pilotless Airplanes

A FRENCH engineer, Edmond Marcotte in *Arts et Metiers* discusses recent progress in tele-mechanics with particular application to pilotless flight. The author considers flight governed from a distant source by radio waves as essentially solved. The problem of interference either accidental or deliberate has been eliminated by the use of so-called selectors. In one experiment a boat controlled by an airplane flying above it was sent crashing into the sides of a cruiser, whose officers had been informed in advance of what would happen and tried in vain to put the wireless control out of commission!

The stability of the pilotless craft has been taken care of by the Sperry stabilizer in which three gyroscopes actuate the controls and keep the airplane on an even keel and flying in a straight line. At starting an anemometer is connected with the gyroscopic stabilizer, so that the plane does not rise before attaining sufficient speed, which would mean a nasty fall back to the ground. To

Subsidy

SPEAKING before the eighteenth annual convention of the Association of Life Insurance Presidents, General Mason M. Patrick, Chief of Air Service urged the insurance companies to grant regular insurance to air travelers and stressed the comparative safety of air transportation.

On the British and Dutch air lines during the past three years the number of passenger air miles to each casualty was 2,663,000. During the five years from 1919 to January 1, 1924, regular air transportation services have carried a total of 121,496 passengers, 8,200,000 pounds of merchandise and 7,145,000 pounds of mail. The loss of packages by the air mail amounts only to five one-thousandths of one percent; for regular registered packages in the United States, the loss is actually greater, namely seven and a half one-thousandths of one percent. Said

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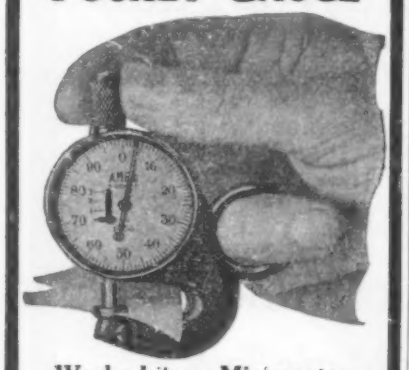

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the General, "The question is often asked, why in this country, whose distances are so much greater, air transportation has not come into being before. The answer is a simple one. The European countries have recognized more clearly than ourselves the military and economic advantages of air transportation companies. They therefore subsidize them. In this country we balk at the word subsidy, yet there is no method of transportation ever employed which has not been subsidized indirectly. Many of our railroad systems were given immense grants of land. The government improves and lights water ways and harbors, and spends millions of dollars on roads. So far nothing of this kind has been done for air transportation."

Perhaps it may.

Man-Power Flight

FOR man to fly with his own unaided strength is a problem that has fascinated inventors from the earliest times. Did not Daedalus escape with beating wings from the Island of Crete, and did not his son Icarus perish when approaching too near the heat of the sun with the same perishable material attached to his shoulders? More recently Paulain, famous French aviator, has won a prize of 10,000 francs for a twenty-foot hop in his "Aviette," a bicycle with wings attached, in which the operator gets up the greatest speed possible by pedalling on the ground until he "zooms" into the air. Fred Gerhardt, at the Army's experimental station in Dayton, went one better than Paulain. He built his "cycleplane" with a large number of narrow wings, and a regular airplane propeller actuated by foot pedals and chain drive, and flew, not hopped, for an instant until his frail craft collapsed in the air.

Is it possible to improve on these attempts and build a practicable flying machine with man's muscles as the sole motive power? The answer is definite: for heavier-than-air craft, no; for lighter-than-air craft, yes. Matthew B. Sellers has examined the question of a man-propelled airplane in the magazine, *Aviation*.

With a man's weight set down as 150 pounds, he estimates a necessary structure and driving mechanism of at least 100 pounds, giving a total weight of 250 pounds. The drag of the plane is dependent on its aerodynamic form, and with clean design may fall as low as 1/12th of the weight. A man would have to exercise a thrust of approximately 20 pounds therefore. Since power is thrust multiplied by speed, he would have to fly as slowly as possible. To fly very slowly means a great area of wing. Sellers estimates that a man could, with violent and short effort, exercise one horsepower, and could then overcome the above thrust at some 14 miles per hour, but his craft would require the relatively enormous wing area of 417 square feet.

A structure of only the 100 pounds postulated must necessarily be fragile and unmanageable—as Gerhardt found to his sad disappointment. And in a heavier-than-air machine flight must be continuous so that our human engine would have to possess extraordinary endurance to maintain flight for more than a few moments.

With a gas-filled bag to supply lift, the prospect is much more hopeful. Umberto Nobile, Director of the Italian Lighter-than-air Construction Corps is the eminent authority who champions as practicable the idea of a sporting dirigible with a crew of three or four men as power plant. Here lift is not dependent on motion, and the dirigible may be propelled as slowly as we please with far less manual exertion, and with the possibility of frequent rests. Hence, according to very careful calculations by the Italian engineer, three vigorous men could propel a small dirigible of some 17,500 cubic feet gas capacity at a speed of 10 miles an hour with an expenditure of only ⅛th of a horsepower each for hours at a time. They could, in fact, stay up as long as gas in the balloon held out. What a fascinating implement of sport a man-propelled dirigible would be!

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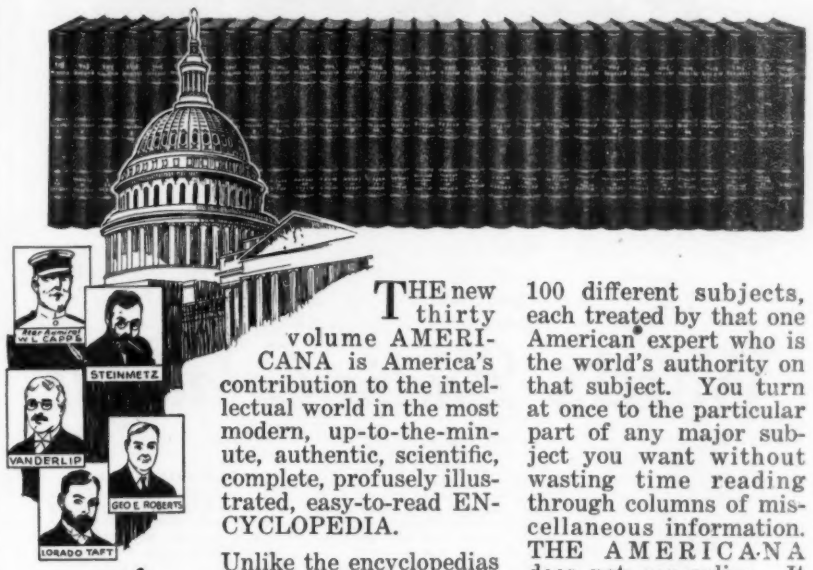

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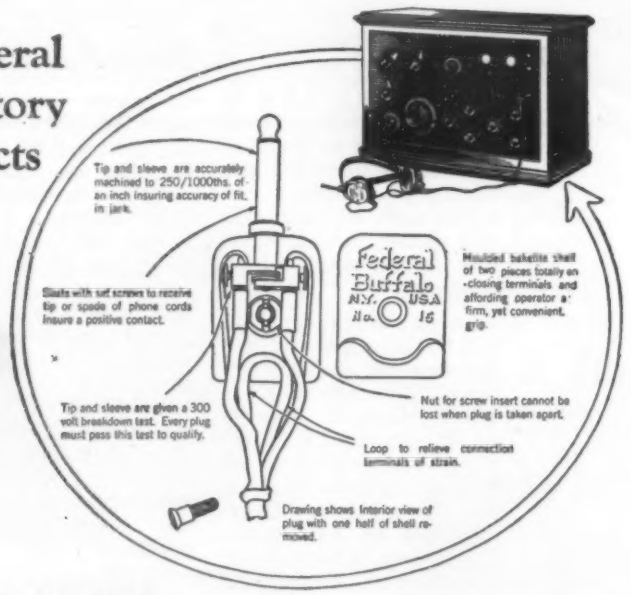
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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Austin C. Lescarboura

Radio's Great Mystery—Fading

WHILE most of us are pretty well resigned to accepting static as a necessary evil in radio reception, all of us are not ready to accept fading without at least putting up a struggle. Static is due to weather conditions. It is doubtful whether we shall ever overcome that variety of parasitic disturbance with the average run of radio receiving apparatus. Superbroadcasting, of course, will serve to drown out the static by giving us signal strengths far above the static or noise level; but that is merely an avoidance, rather than a solution of the problem.

Fading of radio signals is a most peculiar phenomenon. There are localities in which radio listeners are troubled by the fading of the signals from certain stations, while signals from stations much farther away come through the ether loud and clear and with steady volume. Again, in the same locality one broadcast listener may be troubled by fading while another will receive the same signals without trouble. Take a typical case: WGY, a powerful broadcasting station, is difficult to tune in and hold in the vicinity of New York City, although not much more than 150 miles distant. The Chicago stations, almost six times as far away, come in with fairly steady volume. It has been said that the trouble is with the transmitting station of WGY, yet the writer of these notes, located only fifty miles away from WGY, has studied the transmission of that station with an audibility meter and has failed to note any fluctuation over a period of weeks.

One thing that may account for some of the present fading is the congestion of radio receivers in cities. The writer has noticed that much of the fading experienced with long-distance stations may be due to nearby regenerative receivers tuning in on the same wavelength. We are not referring to the "squeal" but to the regenerative receiver sitting squarely on the same wavelength, which apparently absorbs a considerable amount of the energy.

Armstrong, the well-known inventor of the regenerative receiver and of the superheterodyne, called attention to this modern condition a year or more ago. While endeavoring to pick up the signals from WEAF at a distance of 450 miles, he noted the diminishing volume as more and more of the local receivers were tuned in. There was a time when we believed that any number of receivers could be tuned in on the same wave without marked effect, but we never contemplated a situation where half a dozen antennas drape the roof of the same apartment house.

Fading is still a mystery, but there begin to be hopes that it is largely man-made and, therefore, subject to cure. Some of it, however, is probably due to natural conditions, such as the atmosphere, intervening topographical features, and so on.

Aids to Tuning

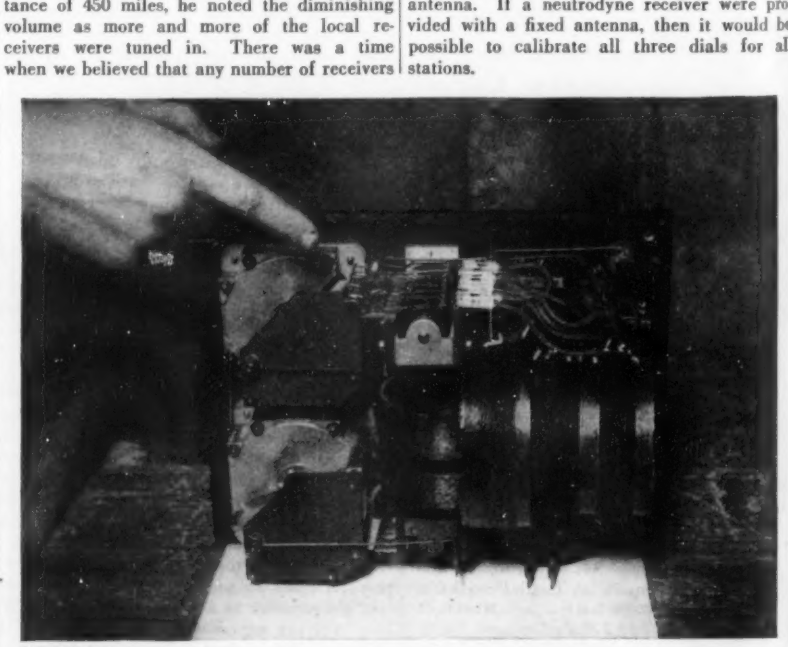
FROM Germany comes an idea which might well be taken up by most of our American broadcasters. The Breslau broadcasting station has a loud-ticking metronome in its studio. This is operated for some time before the start of the regular program in order to give the radio listeners an opportunity of tuning, sharply and clearly. The ticking of the metronome is even better than that of an ordinary clock, which has been employed by some broadcasters in the past between numbers on the program in order that listeners might "hold on" during the intervals otherwise silent.

Simplified Neutrodyne Operation

THE usual neutrodyne receiver, with its three tuning dials, is apt to prove somewhat of a Chinese puzzle when first placed in the hands of the inexperienced broadcast listener. In practically all neutrodyne receivers the three dials are not set to precisely the same number in order to tune in signals; hence there is some difficulty at first in locating the weaker signals.

Now comes a well-known manufacturer of neutrodyne receivers with an instruction book which shows the settings for the second and third dials of each neutrodyne receiver for tuning in any desired station, leaving to the operator the sufficiently easy task of ably tuning the first dial. The operation no longer assumes the aspect of searching for the proverbial needle in the haystack.

This is an excellent idea and might well be carried out by all manufacturers of three-control receivers with sufficiently stable characteristics. The first control of the neutrodyne cannot be calibrated at the factory for the reason that the settings are controlled by the antenna. If a neutrodyne receiver were provided with a fixed antenna, then it would be possible to calibrate all three dials for all stations.



Kadel & Herbert

This German army radio set is said to give greater selectivity than is found in most crystal outfits. The construction is extremely rigid. Litzendraht wire is used on the tuning inductances and the rotary cam switch has a number of prongs which force contact arms against the metal tab connected to each tap in place of the usual switch points

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The writer suggests that the operation of a neutrodyne receiver be studied by the beginner in the following manner: Take an evening when there is considerable static—a warm evening, even in winter or spring, will produce abundant static in a set as sensitive as a neutrodyne. Then, leave the first dial at 0 and set the second and third dials simultaneously until the loudest static response is obtained in the headphones or the loudspeaker. Note the differences in the settings of the three dials. This will serve later as a guide.

Then, set the first dial at 10, and repeat the operation; then at 20, and so on, until the entire scale of the first dial has been checked up with the other dials. The combined positions of all three dials will then be known for best tuning at each wavelength and it becomes much easier to tune in signals.

The Loudspeaker Becomes a Console

A WESTERN furniture manufacturer has hit upon the idea of offering a loudspeaker which is, in reality, a console. The graceful exterior of this console gives no hint of its inner utility, for it is a simple and effective piece of furniture in every line. But a glance at the interior reveals a most ingenious arrangement of the built-in loudspeaker, with space either side and in front. These spaces are ample for the largest "A" battery and the largest storage type "B" battery, as well as for the recharger. An ornamental grill under the table top conceals the horn. The usual receiving set is placed on top of this console, with ample elbow room left in front.

Single-control Receivers

IF we read the signs correctly, the present year will witness a decided trend towards single-control receivers. Already there are several excellent multi-tube receivers on the market, which feature a single-control tuning arrangement. The reflex type of circuit, making use of transformer-coupled radio-frequency amplification, lends itself quite readily to single-control tuning, when working with a loop.

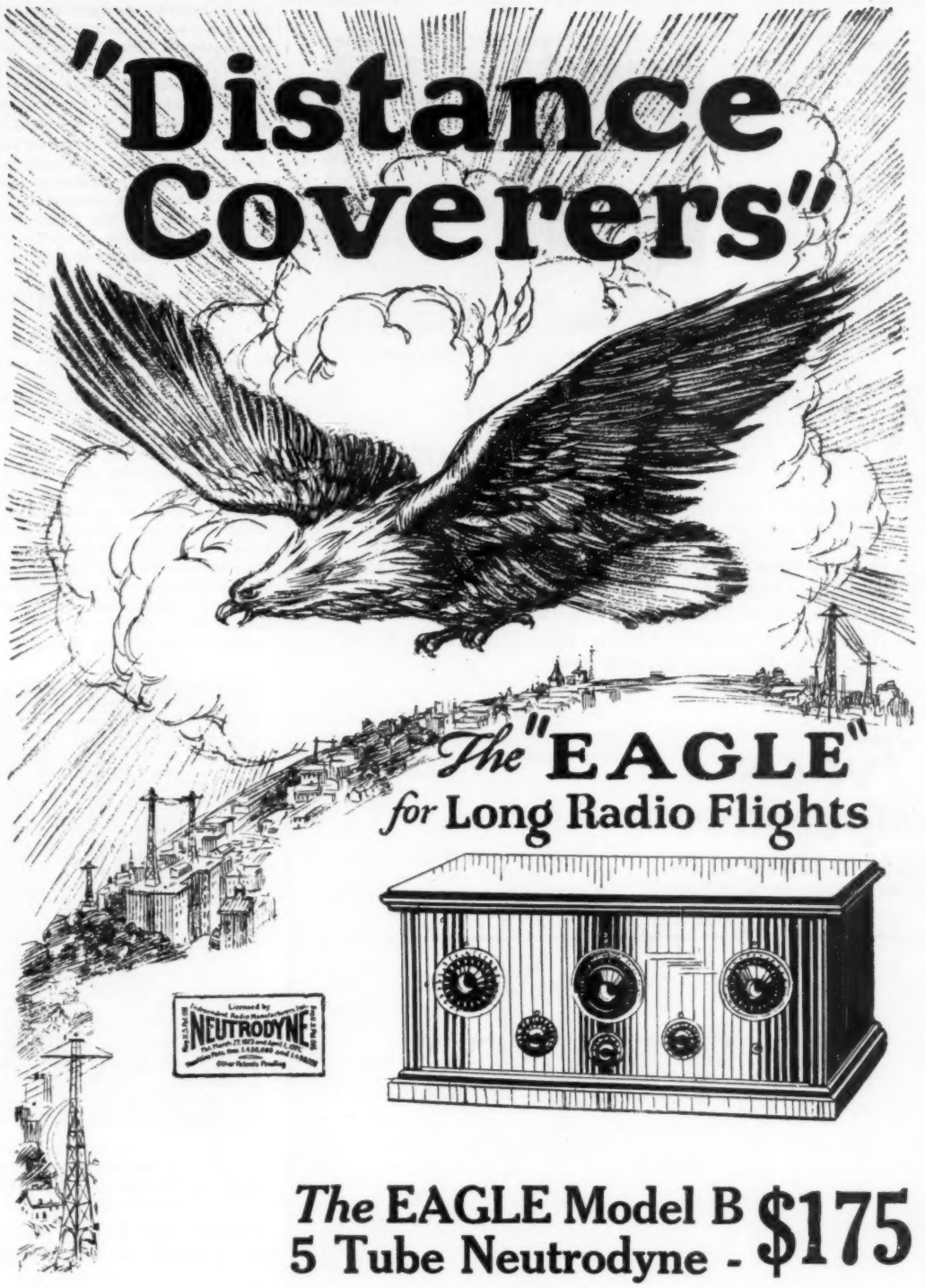
In such a case just the wave-intercepting circuit must be tuned. This can be done with a variable condenser across the loop terminals. Most other circuits, on the other hand, require several adjustments, and it, therefore, becomes a matter of considerable mechanical and electrical ingenuity to combine these adjustments in one control.

Of late, the radio engineers have found ways of designing tuned-radio-frequency amplifier circuits in such a manner that they may be controlled by means of gears or other mechanical coupling. It is but fair to add that such single-control arrangements generally call for broader tuning and somewhat lower efficiency than if each radio-frequency unit were tuned individually. In some single-control arrangements the single-control knob is used for the regular run of tuning, while vernier condensers are employed for sharpening the tuning, especially for DX reception.

Even the rheostat controls can be eliminated for the purpose of making a true single-control receiver. In this case the rheostats are replaced by automatic filament resistances which take care of the tube filaments without attention on the part of the operator.

Radio Standardization

FROM time to time in the past, attempts have been made to standardize radio equipment or methods, according to Dr. Alfred N. Goldsmith of the Radio Corporation of America. It must be admitted, continues this authority, that it is confusing to work in a field where, almost from day to day, there are changes in the types of apparatus and the modes of use of equipment. Yet the attempts to standardize radio equipment up to the present have been uniformly unsuccessful. The fundamental circuits of radio apparatus, while much fewer in number than one might think from the literature of the art, are nevertheless sufficiently numerous and have so many unexplored possibilities that standards adopted at this time would be sure to be overthrown, one might almost say, within a few months.



The EAGLE Model B 5 Tube Neutrodyne - $175

UNDIFFERENT to mere miles, superior to difficulties that balk ordinary receivers, freed of the complications that have heretofore so limited the enjoyment of radio. Capacities precisely *balanced.*

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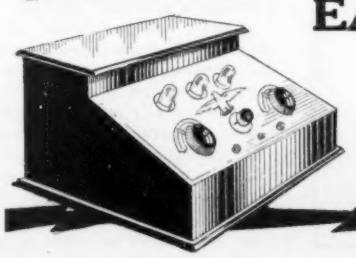

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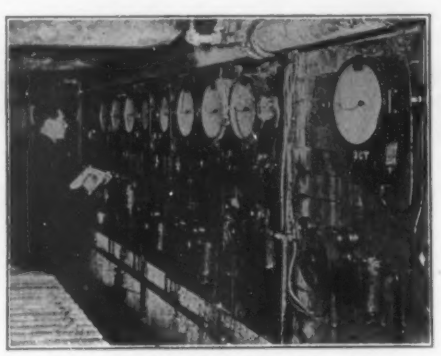

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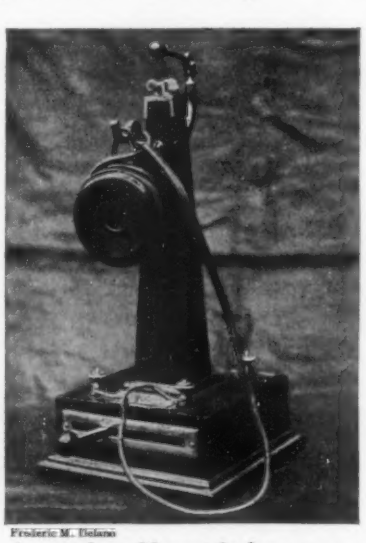
Radio circuits, apparatus construction, vacuum tubes, and acoustic reproducing mechanisms such as loudspeakers, are all evolving rapidly. It will be years before a number of stable forms of radio equipment have been produced and tested to such a degree that standardization will be acceptable and helpful. The radio art is fortunate in having so many potential lines of development, and those who desire early standardization must content themselves with the thought that while this is not possible, yet the rapid growth of the art helps to compensate for its comparative lack of orderly arrangement at this time.

The Hook-up Board and its Purpose

For those who are never contented with anything but the last word in radio circuits, an ingenious idea is set forth by one of our contemporaries. Mounted on what is known as a hook-up board, the experimenter has an array of individual radio instruments, e.g., a vario-coupler, variable condensers, crystal detector, tube sockets, grid condenser and grid leak, rheostat, potentiometer, and transformers, not to overlook simple clips and flexible leads to facilitate laboratory connections. By means of this hook-up board, the radio experimenter can arrange and rearrange the various radio components into any desired circuits for experimentation and study. The flexible leads are provided with clips and tips to facilitate quick wiring.



Frederic M. Dolano

A crystal set like a telephone apparatus. Tuning is done by a small lever in the base which controls the tuning inductance

Government Expert Believes in Linkage of Broadcasting Stations

Judge S. B. Davis, the well-known radio authority of the United States Department of Commerce is convinced that the most important radio development of the past two years is the increasing ease with which two or more broadcasting stations can be linked together, as described in another note in this issue.

"In radio developments during the past two years," says the judge, "two factors are outstanding—the use of the short waves and wire interconnection of stations. Both are of great importance. The short wave has found its place in commercial and amateur trans-oceanic communication and in transmission for rebroadcasting both at home and to places across the seas. In domestic use it is a rival of wire interconnection, both being a means to the same end, the furnishing of simultaneous programs to several stations.

I consider interconnection, in whichever mode effected, almost essential to the future of broadcasting, if we are to look at radio as a means of service to all our people all the time. It ultimately means national programs, nation-wide utterances, more valuable subject matter and that great happenings in which our people have so vital an interest will be made available to everybody. To give them an immediate touch with national and world happenings must result in better citizenship.

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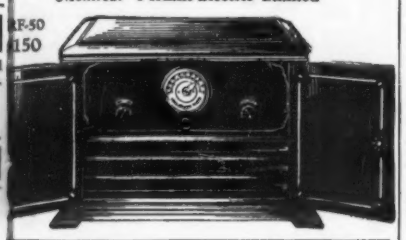

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U. S. Photo

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We have already seen examples of nation-wide communication in the simultaneous broadcasting on several occasions by stations from the Atlantic to the Pacific, and it is now a nightly practice within extensive areas. All this has happened in the past year. It is transforming broadcasting from a local to a national service, and this not by way of detriment to the local stations, which are the backbone of the system, but is an advantage.

Interconnection, with its corollary of national service, is only just beginning. It will go much further. Its development, together with some general rise in the power level of stations for the overcoming of static and interference, giving us really useful reception, will, I believe, be the principal improvements in the immediate future.

I look for remarkable development along these lines for the good of broadcasting.

Will Super-power Stations Dominate the Air?

SUPER-POWER broadcasting stations are now under construction in various parts of the country, so that they are no longer mere dreams. However, it is quite another matter whether super-power meets with universal approval; indeed, such licenses as have been granted by the Department of Commerce for super-power stations are subject to cancellation at any time, in the event that super-power transmitters are found to raise havoc with the broadcasting atmosphere in general.

The "for" and "against" of super-power broadcasting is relatively simple, at least on paper. The argument in favor of super-power is simply that it will increase the strength of radio signals over the strength of static. We shall be in a position to use smaller antennas, and therefore, reduce static disturbances, while at the same time retaining the loud signals. There will be virtually none of the squeals and groans which ruin clear radio reception in so many localities, because it will no longer be necessary to force regenerative sets until they oscillate with the increased strength of the signals. Less amplification will be necessary, which will result in simpler receiving sets and purer reproduction of music and speech.

On the other hand, the argument against super-power has to do with the possibility that a few super-broadcasting stations will dominate the air, thus smothering the smaller broadcasters. It is also contended that DX work may become a rarity, because of the powerful nearby signals. Many radio devotees fear that super-power broadcasting means that they will be compelled to accept specific programs, because they will be unable to penetrate the powerful signals of these super-power stations and reach out for other programs as at present.

However, the counter argument to all this is that the super-power stations are to be located outside crowded metropolitan districts. One super-power broadcasting station has its studio in the city, while the transmitting station is located some twenty-five miles away in the open country.

Transmitting Seven Hundred Miles With One Amplifier Tube

IT was back in 1910 that a wireless amateur—as the radio devotee was called in those days—transmitted signals a distance of seventy miles with a one-inch spark coil. Despite the fact that this feat was performed in California, which has always been famed for its ideal radio conditions, it attracted attention far and wide. Now comes the news that radio amateur A. T. Mitchell (9DCK) of Rockford, Ia., has transmitted signals over 700 miles using a single C-301 amplifier tube, and sixteen volts of "B" battery, in conjunction with a home-made transmitter.

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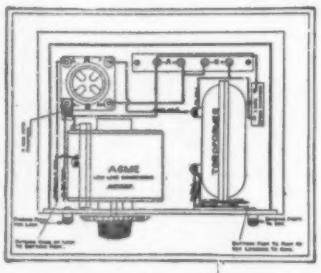

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Overcomes Local Interference

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Notes and Queries

Conducted by Albert A. Hopkins

This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.

Correct Way to Bend Bus Bar for Radio

H. C. L. *asks for simple directions or diagrams showing the correct way to bend bus bar.*

ANSWER: The correct way to bend bus bar is illustrated in these two photographs. Sharp turns should be avoided and the only good way to get round turns is with a pair of long-nose pliers. The bottom photo shows bus bar bent in circle, as it should be, for mounting on transformer terminals.

Kadel & Herbert

The two photographs show the correct way to bend bus bar

When Stars Are Added to Our Flag

R. S. F., Sr., of Me., asks: *Is a star added to the flag just as soon as the President's proclamation announces that a state has been admitted to the Union?*

ANSWER: We have met the opinion that a star was added immediately upon the proclamation of the President that a state was admitted to the Union. To make certain of the fact we referred the question to the librarian of the War Department and have received from him a reference to the law upon the subject. It is found in U. S. Statutes at Large, 3:415, act of April 4, 1818, and enacts that the star for a new state shall be added to the flag upon the Fourth of July succeeding the admission of the state.

In accordance with this law two stars were added to the flag on July 4, 1912, making 48 stars. They have been placed in six rows of eight stars each. The last states to be admitted to the Union were Arizona and New Mexico. Their Statehood bill was signed by the President on August 21, 1911, subject to certain changes in their constitutions. The proclamation of the President has been made admitting these states and their stars became part of the flag on July 4, 1912.

The Blue of the Sky

The young children of P. N. H. have had their curiosity aroused as to the cause of the blue of the sky and possibly a number of our readers may be interested in our reply which is taken from the Meteorological Glossary.

ANSWER: Light rays striking particles which are smaller than the wavelength of the light are *scattered* or turned aside in all directions. The short waves which compose the blue and violet end of the spectrum are more completely scattered than the long red and yellow waves. Hence light passing through a medium containing a great number of such particles is left with an excess of red, while light emerging laterally has an excess of blue. The greater part of the sky appears blue because the light from it consists mainly of light scattered laterally from minute particles in the atmosphere. The smaller the particles the less intense is the light, but the greater the proportion of it that is blue. When the particles are larger the proportion of blue is less as in the whiter sky of a haze.

Near the horizon the sky is whiter than at the zenith because the rays of light from that region have passed through a greater thickness of the lower air where large particles are relatively more numerous. Sunset colors are reddish because the rays reaching us directly have lost much of their blue light by lateral scattering. The sky as seen from high mountains and from airplanes at a great height is of a deeper but purer blue because there are fewer large particles than at lower altitudes.

Ocean Lore

D. N. H. S. asks: *To settle a controversy, what is the greatest depth of any ocean and what are the various ocean areas?*

ANSWER: We cannot do better than give you the figures from Whitaker's Almanac—a standard work of reference.

The greatest known ocean depth (in the Pacific, off Mindanao, 32,089 feet) is not much greater than the greatest land height (in the Himalayas); but the mean depth of the ocean floor exceeds 12,000 feet, while the mean height of the surface of the land area of the earth above sea level is only 2,300 feet. The following table gives the areas of the principal oceans and seas, with the greatest known depth of each:

Oceans

Name	*Area of Basin*	*Greatest Depth*	
Pacific	63,986,000	Off Mindanao	32,089
Atlantic	31,530,000	Porto Rico Trench	31,366
Indian	28,350,000	Sunda Trench	22,968
Arctic	5,541,600	North Polar	13,200

Seas

Malay	3,137,000	Kei Trench	21,342
Central American	1,770,170	Caribbean	20,568
Mediterranean	1,145,000	*Pola* Deep	12,276
Behring	878,000	Buldir Trough	13,422
Okhotsk	582,000	Kurile Trough	10,554
East China	480,000	*About*	10,500
Hudson Bay	472,000	*About*	1,500
Japan	405,000	*About*	10,200
Andaman	305,000	*About*	11,000
North Sea	221,000	Skaggerak	1,998
Red Sea	178,000	20 degrees north	7,254
Baltic	158,000	*About*	12,000

Jaenicke's Mercury Lamp

S. F. L. asks: *Can you give me any references in order that I may obtain a description of Jaenicke's mercury lamp?*

ANSWER: A number of different designs of Jaenicke's lamps are in existence. The one recently referred to in connection with the problem of atomic disintegration consists of a tube of fused quartz approximately five inches long. At each end there is a downward-bent extension of this quartz tube, these two extensions forming mercury wells in which liquid mercury is placed. Into these two mercury wells there are dipped carbon electrodes con-

(*Continued on page 214*)

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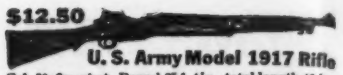

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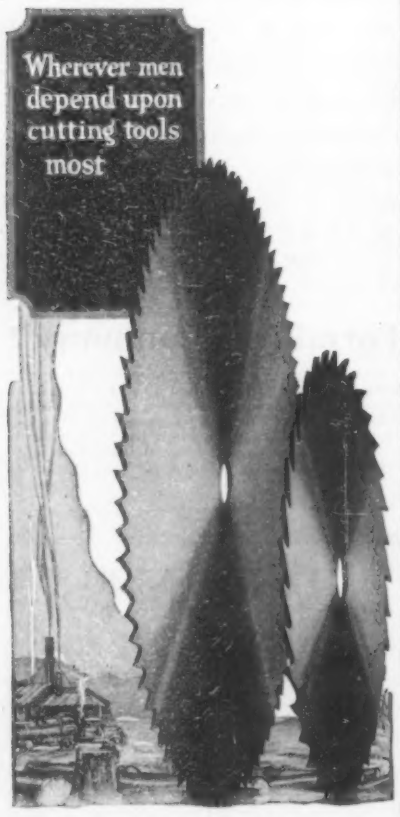

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This lamp operates at a voltage of approximately 170 volts and may be constructed to draw as much as twelve amperes of current.

So far as we are aware, no extensive description of this lamp has been published in English.

A List of Books on Man's Evolution

H. R. W. *wants to make a home study of Evolution, so that he can meet the arguments of the anti-evolutionist. He would particularly like to do systematic reading about the evolution of man, but the little he has been able to find concerning this subject assumes too much previous knowledge of it. He requests a list of books on man's evolution, the books to be planned or grouped in a logical sequence, so that he may progress through them from the elementary towards the less elementary.*

ANSWER: People are no longer content merely to sit on the sidelines and observe the warfare between science and theology which is now being waged by the evolutionists and the anti-evolutionists or fundamentalists. They want to understand the issues and decide for themselves. As H. R. W. says, however, the books he has seen which treat the subject of man's prehistoric past often assume some previous knowledge of anthropology and other sciences. Hence the reader becomes confused by them.

If we were H. R. W. we would begin by reading Chapter 46 of Pirsson and Schuchert's "Text-book of Geology" (John Wiley and Sons, New York), which covers man's evolution in twenty-two pages. This gives one a rapid survey and fills in a rough framework. Then we would turn back in the same excellent book and read the whole story of historical geology, beginning with the youth of the earth, and reaching up through the evolution of fishes, great reptiles, and then mammals, including man.

Without a rough comprehension of the trend of historical geology one could, it is true, understand man's evolution after a fashion. However, a few hours devoted to a study of the geological background of organic evolution and earth history before man evolved would vastly facilitate one's future studies of the evolution of man. It would give a point of view and a sense of proportion.

The next step might well be a reading of "Organic Evolution" (The Macmillan Company, New York), by Professor R. S. Lull of Yale University, particularly Chapters 37 and 38 which sketch the evolution of man about twice as fully, and from a little different point of view, as the work first named. Incidentally, we do not know of any one book which, without going beyond the average intelligent reader's depth, so completely surrounds the whole subject of organic evolution as this one does. This all-inclusive work is a textbook, like that of Pirsson and Schuchert, already mentioned, but like it the treatment of the subject is far from dull.

H. R. W. is now ready to approach any of several of the highly interesting works which have been appearing, especially since the war, on the subject of anthropology and man's evolution, early races, cultures of extinct races, and so on. One such is "Man's Prehistoric Past" (The Macmillan Company, New York), by Prof. H. H. Wilder of Amherst College, covering in clear language the prehistoric past of two hemispheres. However, its treatment of each phase of its subject is somewhat more limited by this fact than is the case with several other works of greater length and less scope.

"Men of the Old Stone Age" (Charles Scribner's Sons, New York), by Dr. Henry Fairfield Osborn, president of the American Museum of Natural History, treats of the anthropoid apes and the early races of man in the Old World in one volume of medium length.

"Fossil Men" (Gurney and Jackson, London), by Professor Marcellin Boule of the National Museum of Natural History, Paris, is a most inclusive treatment of man's evolution and a decidedly lucid one for the beginner.

Any one of these three books might logically follow the reading of the two basic works first named, and the average intelligent reader would then be entitled to consider that he had a fairly good even if not profound comprehension of man's evolution so far as we understand it at this time.

These or any other books that are in print may be secured either from their publishers or through the Scientific American. We are very frequently requested to forward books or groups of books to our readers in all parts of the world, and we perform this service with pleasure.

The Permanent Wave

J. G. H. writes: *"I would like very much to know what chemical is used in the permanent waving of hair and when baked what is the principle involved? I have been a consistent reader of the Scientific American for twenty-five years and believe this a matter of general interest."*

ANSWER: The permanent waving of hair is not essentially a chemical process. The operation depends in reality upon changing the cross-section of the individual hairs so that the hairs become oval at certain places instead of round.

The essential agent in this process is usually heat. The liquids employed to soak the hair before the application of the heat have two functions; first, to make the hair softer so that it is more readily deformed into the oval cross-section, and second to prevent the hair from becoming brittle or actually burned during the period of heating.

The combinations of materials used for this purpose are extremely varied and constitute, in most cases, trade secrets of the persons who are expert in this operation. It must be remembered furthermore that the essential of success in the waving of hair does not lie in materials which are used, but lies in the skilful application of the exact necessary degree of heat in exactly the proper fashion and to the right point on the hair to which it is applied.

The $x + y$ Problem

B. J. K. asks: *"Will you please give a solution of the famous $x + y$ problem which was much in the public eye just a few years ago?"*

ANSWER: Our subscribers of mathematical turn have several times come to grief over this problem. For those having deficient facilities for advice, we submit the following solution:

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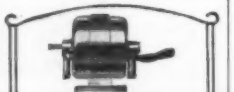

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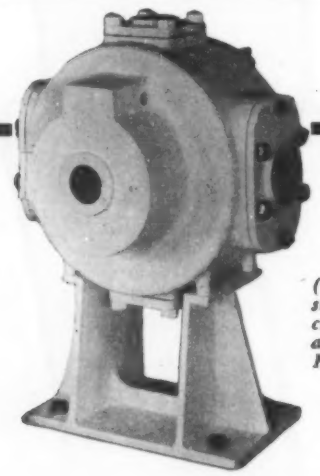

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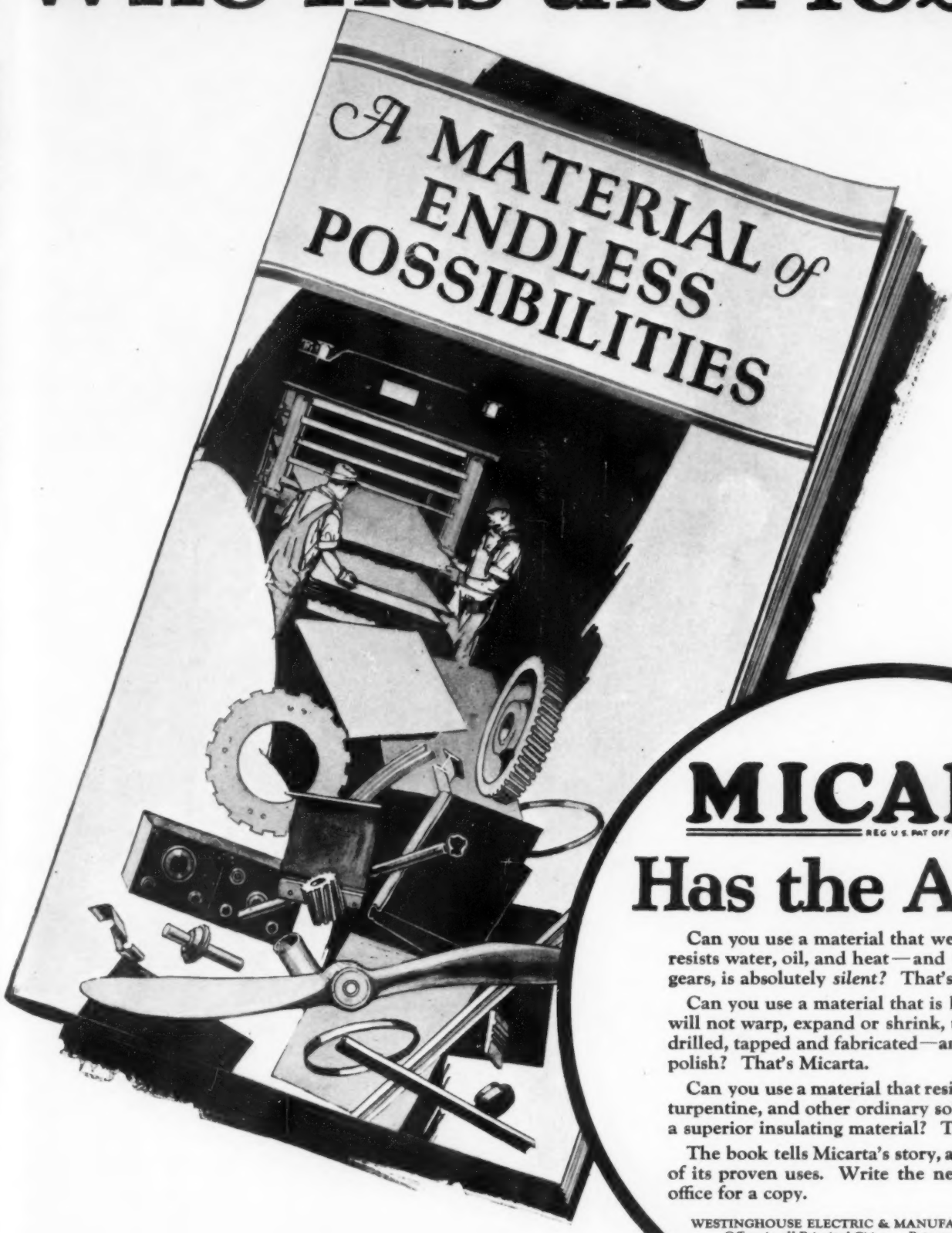

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